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THE FERNS AND FERN ALLIES

OF

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C. ASPLENIUM BULBIFERUM.

All one-fourth the natural size.

THE FERNS AND FERN ALLIES

OF

NEW ZEALAND

With Instructions for their Collection and Hints on their Cultivation

BY

GEORGE M. THOMSON, F.L.S.
SCIENCE TEACHER IN THE DUNEDIN HIGH SCHOOLS

WITH FIVE PLATES

GEORGE ROBERTSON
MELBOURNE, SYDNEY, ADELAIDE, AND BRISBANE
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PREFACE.

THE demand for a compendious and handy description of the Ferns of New Zealand has led to the publication of more than one little work on the subject; but from one cause or another these books have rapidly passed out of print, so that the collector—desirous of identifying the plants he obtains—is obliged to consult Hooker's "Handbook of the New Zealand Flora," a work which is too general in its outline for his purposes, and which is already somewhat out of date. To satisfy this demand, the author has been led to prepare this small manual, in the hope that it will meet the requirements of the case and will prove to be longer-lived and of more lasting value than its predecessors.

The usual demand in such a work is that it shall be written in a "popular" style and in "popular" language—in other words, that all technical terms shall be avoided in descriptions. Books of this class are in the majority of cases unsatisfactory, usually lacking that scientific accuracy which is the first requirement of such works, but chiefly being defective in conciseness of description and exactness of phraseology. They fail to satisfy those who want scientific descriptions, and are not sufficiently explicit for those who have little knowledge of the subjects treated of. A large technical vocabulary has grown up round the literature of ferns, which it is impossible to ignore altogether. No one can lay claim to a knowledge of these plants without knowing something also of this terminology; for it is impossible to examine ferns without finding characters and points of structure which our ordinary vocabulary fails to describe aptly. There is hardly any pursuit or study which has not a terminology of its own, and the student of ferns will find that there is such a terminology in his branch, and that it has to be mastered before he can make satisfactory progress in the identification of species. The author has therefore deemed it advisable to write the descriptive

part of the work in technical language, avoiding, however, all unnecessary multiplication of terms; and at the same time—by a clear introductory chapter on the structure of ferns and their allies, and by the aid of a complete glossary—to enable the reader to understand every term used. There is no serious difficulty in mastering these terms, as a little patient application will prove, and there is no satisfactory way of avoiding their use without sacrificing the scientific value of the descriptions. If any are afraid to enter upon the study of our ferns because there are some apparently hard names to be got over, we would advise such persons to turn their attention to something else. If the subject is worth studying, no one need grudge taking a little trouble about it.

In the preparation of this work, every available source of information on the subject has been consulted. While differing on some points from those whose labours he has availed himself of, the author has to acknowledge the very valuable assistance which he has received from various sources, and chiefly from the writings of Messrs. Colenso, Kirk, Cheeseman, and Potts—botanists who have done much to bring about the present well-advanced state of scientific knowledge in this young country.

DUNEDIN,
January, 1882.

THE FERNS AND FERN ALLIES OF NEW ZEALAND.

CHAPTER I.

THE STRUCTURE OF FERNS AND ALLIED PLANTS.

WHAT is a Fern? The question is often asked, but it is not always easily answered, at least in a manner satisfactory to the questioner. It will not enlighten the majority of inquirers to say that—"A fern is a vascular cryptogam, bearing well-developed leaves which have usually simple or forked veins, are circinate in vernation, and bear sporangia almost always collected into sori on their under-surfaces or margins." While, no doubt, perfectly true and quite satisfactory to the botanist, this description might—as far as its general application is concerned—be couched in Greek. It will be advisable, therefore, to explain what the above definition means, and in doing so we shall hope to give an explanation which will be comprehensible by those who know nothing of botany.

The majority of our cultivated plants bear their organs of reproduction in tolerably conspicuous groups, which we call the *flowers* and *fruit*. A single flower, like that of the strawberry, for example, contains a large number—probably from 50 to 100—of these reproductive organs, and they are called respectively the stamens (male organs) and pistils (female organs). By the fertilizing action of the former on the latter, the seeds are developed. When the other parts of the flower have fulfilled their functions, the pistils continue to increase in size, forming the fruit which we see when ripe as little seed-like bodies (popularly known as the seeds) on the outside of the succulent strawberry. These contain the true seeds, which, when sown, give rise by direct growth to similar plants to the one which produced them. All flowering plants are furnished with stamens

and pistils; and as these are generally visible to the naked eye, the whole of this large class of plants is included under the general term of *Phanerogams* (Gr. *phaneros*, evident), or plants with conspicuous organs of reproduction.

But there is another still larger class of plants which have no stamens and pistils, and whose reproductive organs are in many cases so minute that the aid of the microscope is required to bring them to our view. To this class belong Ferns and their allies, Mosses, Mushrooms, Lichens, Seaweeds, and numberless allied forms, and they bear the general name of *Cryptogams* (Gr. *cryptos*, concealed), or plants with inconspicuous organs of reproduction. These plants produce, in different parts of their structure, minute reproductive organs termed generally *spores*. When we shake a dried fern-frond, we frequently shake out a cloud of these in the form of a fine brown dust. If the fresh spores of a fern are placed under suitable conditions of moisture and warmth, they germinate and give rise to a cellular growth, like a miniature seaweed, called a *prothallus*. This prothallus—which, in the case of most ferns, is not more than $\frac{1}{10}$th to $\frac{1}{30}$th of an inch in diameter—is formed of several cells usually arranged in a more or less plate-like manner. It is furnished with root-hairs, but is without a distinct stem or leaves of any kind. On this miniature and short-lived plant, true sexual organs are produced which, after fertilization, give rise to a second plant—the true fern-plant. All the plants allied to ferns have the same general mode of reproduction, so that in this whole group we notice what is termed an "alternation of generations." The first of these is *asexual*, the spore giving rise to a prothallus; the second is truly *sexual*, and produces a fern-plant similar to that from which the original spore was developed.

This alternation of generations is a primary distinction between Ferns and Flowering Plants—because though probably it occurs in the latter, still it is at such an early stage of the development of the seed, that botanists have not succeeded in fully detecting it.

Again, from the lower orders of Flowerless Plants, Ferns and their allies are distinguished by many characters which testify to their much higher state of development. The most manifest distinction is that of possessing woody tissue in their stems—this being absent in all the other cryptogams.

But really to understand fully the meaning of our first technical definition, and to obtain a clear idea of the structure of the different parts of ferns and note the application of the various terms applied to them, we cannot do better than take a few growing specimens of some common kinds and examine them in detail. We can then compare them together and note the similarities and divergences of their structure. I often hear the remark "I am very fond of ferns, and like to gather and press them, but I don't know anything about them, you know, as to their names and that sort of thing." If anybody is really fond of ferns, such an one will not grudge a little trouble to know something about them, and I can assure my readers that any trouble taken for such an end will more than repay itself in the increased zest and pleasure it will bring with it.

For the purpose of our first examination then we will take three very familiar ferns, which anyone will be able to distinguish, and which can be obtained in almost every part of New Zealand. These are figured on the frontispiece, and are *Polypodium billardieri* (fig. A), a common climber on trees; *Lomaria fluviatilis* (fig. B) and *Asplenium bulbiferum* (fig. C), the two latter being terrestrial ferns.

Let us examine the *Polypodium* first. The stem (fig. A 1)—known as the *rhizome*, from its root-like appearance—is many feet in length, and as thick as one's little finger, and is covered with closely-pressed brown scales. It bears at irregular intervals the leaf-like branches, technically called *fronds*, but more commonly the leaves. The stalk which forms their lower part (fig. A 2) is called the *stipes*, while the continuation of it through the flat green lamina of the frond (fig. A 3) is the *midrib* or *costa*, from which again *veins* and *veinlets* branch. In the plate the arrangement of the veins cannot be made out, but it is a very prominent feature in the fresh fronds. The veins are seen to diverge from the midrib nearly at right angles, then to branch into two, and these to branch again. In the spaces between the main veins—termed the *areoles*—the fine veinlets are seen to disappear in the texture of the frond. A representation of this mode of branching is shown in Pl. III. fig. 7, where a portion of one of the fronds of this fern has been drawn. The frond is either all of one piece with continuous uncut margins (as in fig. A 3) when it is *simple*, and its margin *entire*; or it is more or less cut into. Thus in fig. A 4, the blade is cut into numerous long narrow

divisions or *lobes*, but as the cutting does not extend to the midrib, the blade is still all of one piece and therefore simple. It is, however, said to be *pinnately lobed*, and the correct term to apply to it is *pinnatipartite*. Had the incisions extended only about half-way from the extremity of the lobes to the midrib, the leaf would have been termed *pinnatifid*. In describing the shape of such a frond, an imaginary line is drawn round the tips of the lobes, so that the general shape of the outline is given; in this case it might be described as *broadly elliptical-ovate*. The frond A 3 is *linear*, as are the lobes of A 4, while the apices of both fronds are *acuminate*. At the left side of the rhizome a small entire frond is figured, which is *linear-oblong* in shape with a *sub-acute* apex, while the very small frond on the extreme right is also linear-oblong, but with an *obtuse* apex.

On the back of the mature fronds, and placed on the secondary veins, are two rows of orange-brown spots, varying from $\frac{1}{12}$th to $\frac{1}{8}$th of an inch in diameter, commonly known as the seed, but called by botanists the *sori* (sing. *sorus*). These sori are groups or collections of the reproductive organs, and their presence on the back of a frond is one of the chief points of difference between fronds and ordinary foliage leaves, as the latter do not—in flowering plants at least—bear these organs. If a single sorus is examined—and here the aid of a good magnifying lens will be needed—it is found to consist of a number of minute oval bodies (the *capsules* or *sporangia*, see Pl. I. fig. 4*a*) joined by a short stalk to the frond. These capsules are nearly surrounded by a jointed ring or band (the *annulus*), which passes vertically over them, and which, by its elasticity, serves to rupture them when mature. The bursting of each capsule liberates a number of minute rounded or triangular bodies—the *spores*—which fly out as a fine dust. This dust is frequently spoken of as fern-seed, but the term is quite incorrect, as a spore is not a seed, but is more comparable to a miscroscopic bud.

If we now take *Lomaria fluviatilis* (fig. B), we shall find the same parts, but with very considerable diversity of form. Here the rhizome (fig. B 2) is short and erect, being rendered thick by the bases of old stipes which remain attached all round it, while the fronds stand in a tuft from its upper end. Such a rhizome is often called a *rootstock*; and though so different in length and appearance from

that of the *Polypodium*, it is yet a similar organ, only very much contracted. The fronds, also, are very different in appearance, and are distinctly of two forms (hence called *dimorphic*); one of these (fig. B 6) being the *sterile* or *barren* fronds, and the other (fig. B 5) being the *fertile*, or spore-bearing. The function of the barren fronds being chiefly to aid in the nutrition of the plant, they are tolerably large and well developed, while the sterile ones are reduced to the smallest size compatible with the production of the numerous spore-capsules developed on them. Instead of having a single blade, or lamina, on their short stipes, both forms have a number of separate small blades or leaflets (the *pinnæ*) arranged along the midrib of the frond, which is in this case called the *rachis*. This rachis is not smooth and polished as is the stipes of the *Polypodium*, but is clothed throughout with slender, pale-brown scales. The pinnæ, which are either opposite or alternate with one another, approximate together till at the very apex of the frond they are in close contact, and their bases are said to be *decurrent*, as they form a wing on the rachis. A frond bearing such pinnæ is said to be *pinnate*, except at the very top, where—the leaflets having become continuous—it is only pinnatifid. The separate pinnæ in the right-hand frond are *oblong* in shape, while the broadest of those on the left are *broadly-elliptical*; both have their margins minutely toothed. If we examine the underside of one of these pinnæ, we notice a midrib having a few scales on it, and from it a number of fine veins branch, each of which divides almost at once into two equal and nearly parallel arms, like the two branches of a tuning fork. This mode of branching in two's, whether it occurs in veins (Pl. IV. fig. 2) or in the branches themselves (Pl. IV. fig. 1), is termed *dichotomous*. No traces of sori are to be found on these pinnæ, and the frond is therefore termed sterile.

The other fronds of this same plant (fig. B 5) are very different in appearance, owing to the pinnæ being extremely narrow, and to their standing almost parallel with the rachis. On turning up the underside of one of these pinnæ, it will be seen that the margins are turned back very completely, and in the hollow thus formed the capsules are crowded in a dense, continuous line. The recurved edge of the frond thus forming a covering to the confluent sori is termed the *involucre* or *indusium*. (An enlarged section of the

sorus and its involucre, as it occurs in another species—viz., *L. banksii*—is shown in Pl. II. fig. 8*b*.) So closely do the recurved margins of the pinnæ and their included capsules come to each other, that all trace of the venation is hidden; but it is on the extremities of the closely-approximating veins that the sori are placed. The spore-capsules and their contained spores are so similar in general appearance in the three ferns chosen, that we need not here refer to them again.

Our third example, *Asplenium bulbiferum* (fig. C), differs from both of the others in many points, and agrees in many others. Owing to the great size of the specimen selected, only a portion of the frond—which when complete was nearly 3 feet long—has been represented on the frontispiece. The rhizome is short and thick as in the *Lomaria*, and more or less scaly, while the fronds stand in a tuft at its apex. In them there is not the same separation into sterile and fertile, but all are nearly similar, and when mature are spore-bearing. And here we may note, that the young fronds of all ferns have a very different mode of unfolding from ordinary foliage-leaves. They are rolled up from the apex to the base in the form of a crozier, and their *vernation—i.e.*, the position occupied by them while in bud—is said to be *circinate*.

The mature frond is furnished with a stipes and rachis (which is often dark-coloured on its upper side), but this, instead of bearing pinnæ, bears a secondary set of rachises, and these again a third. In the upper parts of the frond, however, the secondary rachises only bear leaflets. In such a frond, the secondary rachis and all that it bears constitutes the *pinna*, the tertiary rachis and parts form a *pinnule*, while the further subdivisions are the *lobes* or *segments*. A frond with pinnules arranged along its secondary rachises is *2-pinnate* or *bipinnate;* if its pinnules are again cut into separate parts, it is *3-* or *tri-pinnate;* and if still further subdivided it is *decompound*. It is often a matter of considerable difficulty deciding what term ought to be applied in describing the extent to which the division of the frond is carried, owing to the fronds being cut almost to the rachises, but having these winged in many cases with a portion of the lamina. Thus some ferns are said—in the "Synopsis Filicum"—to be 2- or 3-pinnatifid, which are described as 2- or 3-pinnate in some other works. The rule here

ought to be that where the blade is distinctly interrupted into separate pinnæ or portions, the term pinnate, or 2- or 3-pinnate, should be employed; but if the portions are united by continuations of the lamina, the frond is still a simple one, and the term *pinnatifid* should be adopted. It will still be found, however, that the application of the rule is by no means easy, as many ferns are pinnate below and pinnatifid above, and nothing but practice and good observation will enable anyone to apply the correct terms.

The venation of our *Asplenium* is seen to be different from that of both the others examined, the midrib which traverses each pinnule sending out single unbranched veins alternately to each of the lobes or to their ultimate segments. Along one side of each of these veins, and placed obliquely to the midrib, is attached a slender, elongated, pale-coloured membrane—the *involucre*—covering the linear sorus. When the spores are mature, this ruptures along the side next the margin of its segment, and discloses to view the sorus formed of a dense line of closely-crowded capsules. Near the extremity of many of the segments of this fern small swellings or outgrowths, bearing a few very young leaves, may be noticed. These are the *bulbils* or *gemmæ*, from the presence of which the species received its second name—*bulbiferum*, or bulb-bearing. Plants bearing such bulbils are said to be *proliferous*. If these little growths, together with a small portion of the frond to which they are attached, be removed and planted in fine, damp soil, they will grow into new plants.

If we now seek to apply all the terms we have learned to other ferns, we shall find that the same organs show many diversities of structure besides those afforded by our three selected examples. We shall consider the parts in the order already followed.

The *rhizome* in many species is very much elongated, creeping underground in some, as in the common Bracken (*Pteris aquilina*), or above-ground, as in one of our commonest Maidenhairs (*Adiantum affine*). In tree-ferns it is elongated into a more or less erect *trunk* or *caudex*, the upper part of which is often clothed with the bases of the stipes of old and withered fronds, while the lower portion is usually thickened by root-fibres. Between the long creeping or climbing rhizome of some species, and the stately trunks—often 20 to 40 feet high—of some of our handsomest tree-ferns, a nearly continuous gradation may be noticed.

The *stipes* varies in different species chiefly in its relative length and thickness, and in the presence or absence of scales and other appendages.

But it is in the *fronds* that the most conspicuous distinctions are to be found, in their size, form and texture. They vary from not more than about half-an-inch in length (as in *Hymenophyllum cheesemanii*) to as much as 20 feet in the giant Mamuka (*Cyathea medullaris*). Some are quite simple in form, while others are cut into innumerable little segments. In many *Hymenophyllums* (filmy-ferns) the texture is more delicate than tissue-paper, and the tissues are formed of a single series or layer of cells; while in *Polypodium serpens* the consistence is that of leather. The surface is also very variable; being glossy and quite destitute of hairs (*glabrous*) in many species, or in others variously clothed with hairs or scales of extremely different lengths, coarseness and abundance.

Among the most characteristic features in ferns are the shape and position on the frond of the *sorus* or collection of capsules, and the presence or absence of its *involucre* or covering membrane. We have already seen that they are sometimes round and placed on the back of the frond, or linear and close to the margin, or are in a continuous line round the margin. In the *Polypodiums* they are naked, having no covering of any kind, while in *Lomaria* and *Asplenium* they are seen to be furnished with some sort of an involucre or indusium. The structure of this covering is very various, but we can only consider it as it exists in a few genera. (For its many modifications, the reader must be referred to Chap. III.) In some cases, as in the *Aspidiums*, or Shield-ferns, the involucre is a small circular disc fastened by the centre of its under surface to the middle of the sorus (Plate III. fig. 3*a*), and it is from this shield-like mode of attachment that both the scientific and common names of these ferns are derived. In the allied genus *Nephrodium* the involucre is kidney-shaped, but otherwise similar. In these, and in *Asplenium*, the involucre is a specially-developed structure of the epidermis of the frond. In *Hymenophyllum* and its allied genera it appears to be an outgrowth of the tissue of the frond itself. In them the veins are produced beyond the margins of the frond, and the capsules are clustered near their extremity, and

covered by a 2-valved involucre, the lips of which open outwards (Pl. I. fig. 7*b*). This prolongation of the veins is termed the *receptacle;* in the true filmy-ferns it occasionally protrudes beyond the lips of the involucre, when it is said to be *exserted.* In *Loxsoma* (Pl. I. fig. 6*a*) and in *Trichomanes* (Pl. I. fig. 8*a*) this receptacle is usually very considerably exserted, and the involucre is still further modified into a long narrow tube or cup.

In *Adiantum* (Maidenhair) (Pl. II. fig. 3), *Hypolepis* (Pl. II. fig. 4), *Lomaria*, and many other genera, the involucre is often termed a false one, being the result simply of the margin of the frond being turned or rolled back over the sorus. One of the most anomalous forms is to be found in *Marattia*, in which the capsules are united into boat-shaped groups, called *Synangia* (Pl. IV. fig. 2*a*). Until the development of these peculiar sori has been fully investigated, we cannot decide how they are formed nor what relation they hold to the sori of other families of ferns. So different are they in structure and development that Sachs considers that the whole family to which this genus belongs should be removed from the true ferns, and classed, together with the Ophioglossaceæ and Equisetaceæ (horse-tails), in a separate group or order by themselves.

The only other point we need to note here in regard to the external form of ferns is the shape and structure of the capsule (*sporangium*) itself, and the position of the ring. The former is formed of a single layer of cells arising from the outer skin or epidermis of the frond, and the ring is a layer of the same group of cells somewhat modified in form. The capsules vary in form, some being globular (*Gleichenia*, Pl. I. fig. 1*a*), others pear-shaped (*Polypodium*, &c.); but it is the position of the ring which is the most marked feature in them. This constitutes, in fact, the most distinctive character by which the tribes of ferns are separated from one another; but as it is detailed in full in Chap. III., it is not necessary to go into much explanation of it here. It is worth noting, however, that when the annulus is transverse (as in *Gleichenia*) or oblique (*Cyathea*), or when it forms a cap on the top (*Schizæa*), then the opening or dehiscence of the capsule is necessarily longitudinal; while, if the ring is vertical, passing over the top of the capsule, the dehiscence is transverse. This is found in all the tribe of the Polypodiaceæ, to which by far the largest number of our ferns belong.

In many ferns, minute jointed hairs, called *paraphyses*, occur among the capsules.

I have said nothing in this chapter of the general structure of the fern allies, because to do so would occupy too much space in a work which is chiefly devoted to ferns. But in the following chapter I have shortly described the most characteristic features of their orders, while in Chap. III. all the species to be found in New Zealand are treated of in detail.

CHAPTER II.

NOMENCLATURE AND PRINCIPLES OF CLASSIFICATION.

ALL plants, when scientifically described, have two names given to them; the first of these is the *generic* name, or that of the *genus* to which the plant belongs; the second is the *specific* name, or that of the particular *species* of plant. This binomial nomenclature—or giving of double names to plants—was one of the many revolutionary changes in the march of scientific progress which we owe to the celebrated Swedish naturalist Linnæus.

The generic names (of ferns at any rate) are usually derived from the Greek; and, in giving such names, botanists have often been guided by very fanciful considerations. The name most commonly used among the genera of ferns is *Pteris* (Gr. *pteron*, a wing), originally given by Linnæus to the common Bracken. This being one of the commonest of ferns, the name has come to be used very frequently as synonymous with the name *fern*. Besides the genus *Pteris* itself, we have, however, only one New Zealand genus into whose name this term enters, viz., *Cystopteris* or Bladder-ferns.

The specific name is commonly of Latin origin, and is often expressive of some characteristic feature of the plant (e.g., *hirsutum*), or of its habit (*scandens*), or of the locality where it occurs (*tunbridgense*), or it may be given in honour of some botanist or collector —usually the first discoverer of the plant (*cunninghamii*). It is usual to commence the generic name with a capital letter, and the specific name with a small letter, even when it is derived from a proper name.

Frequently the same fern has been found in different countries, and named by different botanists, whose descriptions may have been published in any one of the numerous British or foreign publications brought out so abundantly during late years; and thus it comes to have two or more names. Or the same botanist may have obtained two or three varying forms of the same plant; these he describes under different names as being distinct species, and then someone

else, examining these *species*, comes to the conclusion that after all they are only varieties, and he accordingly disallows all the names but the first. As we shall see further on, there is great confusion in the minds of many botanists as to what a species is, and hardly any two can agree as to where the line between species and varieties is to be drawn. Many very celebrated botanists are in favour of reducing the number of species by widening their limits, while others look upon comparatively slight variations as of specific importance. In this last category the majority of cultivators and collectors of ferns, and horticulturists generally, must be included. One result of this difference of opinion is that some favourite kinds of plants have had so many names given to them that systematic botanists have great difficulty in clearing up the confusion which exists. Ferns have probably suffered more in this respect than any other plants, owing to their having been so long collected and cultivated, and also to the wide geographical range of many of the species. The rule for settling this difficulty is a simple one, the first name given being entitled to priority, and being distinguished by having appended to it the name—or a portion of the name—of the botanist who described it; for example, Pteris aquilina, *L.*, informs us that Linnæus was the author of the name. Any later name given to this fern ranks only as a *synonym*. The application is by no means so simple as the rule itself, and often, in spite of great care, extreme confusion has crept into the nomenclature of ferns, to remain until someone has had the courage to face the difficulty, and reduce the chaos to something like order. The work which has done more than any other to effect this is probably the "Synopsis Filicum" of the late Sir W. Hooker and Mr. J. G. Baker, of Kew. In New Zealand, we are indebted to Mr. Kirk for some valuable work of the same kind.

Frequently a fern is described as belonging to a certain genus, and it is afterwards found that it should have been included in another. In this case the specific name first given remains, although the generic name is changed to the correct one. Thus Sir W. Hooker described a certain fern, and named it after the discoverer, *Trichomanes malingii*. On examination of more specimens it was found that the plant was a true *Hymenophyllum*, and hence it is now called *H. malingii*.

Some persons profess to have a great aversion to the scientific names of plants, and say—"Why do you not give simple English names that we could understand, instead of the unpronounceable names you employ?" The remark is expressive only of ignorance or indolence. Anyone who has taken the trouble to study the subject at all knows that it would be next to impossible to devise a system of English names which would be at all suitable. If any are desirous of undertaking such a work, I would recommend them to try their hand, say, to begin with, on the Australian gum trees (belonging to the genus *Eucalyptus*, of which the "Flora Australiensis" enumerates 135 species), or on the Wattles (genus *Acacia*, of which 293 species are described in the same work). But in reality there is, after all, no such difficulty, especially when we consider how many purely technical names of plants have come to be used familiarly, even by the most unlettered. It will suffice just to mention, *inter alia*, Anemone, Ranunculus, Gladiolus, Dahlia, Chrysanthemum, Fuchsia, and Geranium, not one of which is an English name.

To turn now to the principles on which the classification of our ferns is conducted. Formerly, in arranging plants, special points of structure were selected as characteristic of the various classes, groups, and divisions, and by these arbitrarily-selected characters all plants were classified. Any such system of classification—which fixes on one or more distinctive features and ignores all the rest—is termed an *artificial* system, and the most celebrated is that of Linnæus, called after him the Linnæan system. This not only superseded all those which had been in use before it, but remained the only system in general use till very lately. As regards ferns and other flowerless plants, this system had very little application, as it dealt chiefly with flowering plants.

If, however, instead of taking a single character, or even a group of characters, as the basis of classification, we examine into the whole life history of our plants, and unite them by their apparent relationships into species, genera, families, &c., we shall have constructed a *natural* system of classification. Since the publication of Darwin's "Origin of Species," and the immense impetus given to all biological research by that "letting in of light," it has become more possible every day to attain to a natural classification of plants on a genealogical basis. This desirable consummation is still a long way off, however,

and, in ferns particularly, many classifiers—chiefly those of the old school—adhere to purely artificial distinctions. These are very useful in drawing up keys to enable a particular fern to be easily recognized, but should not form the basis of our system.

Suppose we are collecting ferns in the damp forest of one of our West Coast sounds, we find the ground covered with a luxuriant growth of kidney-fern (*Trichomanes reniforme*), and, on examination of a great number of specimens, we agree that they are all so similar that they must be of one and the same kind. Some have large fronds, others small; some are on tall stipes, others on short ones; some are nearly black, and have their margins fringed with sori, while others are of a delicate green colour, and are quite smooth on the edge; yet, despite these and other differences, we have no doubt that the spores of these ferns will only produce other kidney-ferns. Further, were we to come across exactly similar ferns—varying to the same extent—near Auckland, we should be justified in asserting that they were of the same kind as those from the West Coast of the South Island. Now, the whole assemblage of these kidney-ferns, wherever we may find them, constitutes what we term a *species*, and we give it two names in accordance with the rule already explained. We should, further, be justified in assuming that if we could trace back these ferns for an indefinite number of generations, we should at last find that they were all descended from one parent plant which grew at a very remote period either in New Zealand or in some portion of the now submerged land which at one time probably formed a connection between New Zealand and Australia, or some of the outlying islands to the north of this colony.

From these considerations, we may define *a species* as an assemblage of individuals agreeing so closely that they may be considered to have all descended directly from a common ancestral form. But it is conceivable, that, owing to causes which we are not able to fathom fully, a kidney-fern might be produced differing slightly but persistently from its immediate parent plant, and this difference might be perpetuated and perhaps intensified in succeeding generations. In course of time the differences or variations thus induced might be so perceptible and constant as to justify us in calling the plant *a variety*, and after a still further lapse of time—if the conditions which caused the first variation continued to act, or if

other conditions were superadded—the change at last might be so marked as to entitle the modified plants to rank as a distinct species. Now, though this is no doubt the correct idea of the term "species," it is not by any means always an easy thing to make application of the principle. It is simple enough in the case of such a distinct and well-characterized plant as the kidney-fern, and we can draw up a specific description of these ferns, as they are found in the bush of the West Coast sounds, which will apply equally well to those gathered in the Auckland district.

But now let us go into the bush again, and gather a plant of *Asplenium bulbiferum*. Were we to describe its form, it would be found that the description would not apply very closely to another plant, perhaps from the same part of the bush, which yet was near it in most of its features. The first-gathered plant might look at first sight a very different plant from the second, but if we were to collect a very large series of somewhat similar plants, and were to find (as we probably should in the example selected) that though the two most diverse of those chosen had very considerable differences of external form, yet that a complete gradation could be traced through the intermediates, we would still be justified in assuming that all were but forms of one very variable species. It is exactly on this point that so many botanists differ in opinion, and it becomes to a great extent a matter of individual judgment to decide what rank is to be assigned to the variation of plants. If I have erred in this respect, it will be found to be in the direction of increasing the limits of the respective species so as to include doubtful and varietal forms, rather than in multiplying unnecessarily the number of species already defined.

"When several species resemble each other so distinctly that their general appearance indicates a relationship, they are grouped together in a *genus*" (Prantl). But this is seen to be as arbitrary a definition as that of a species, and consequently it happens that botanists disagree very much as to the limits of various genera. Sir W. Hooker and Mr. Baker in the "Synopsis Filicum" give a wide range to the genera, while Mr. J. Smith—author of the "Historia Filicum," and a great authority on Ferns—subdivides the genera to a very great extent. In this respect, again, it will be found that very artificial limitations are frequently put upon the

genera, and particularly by those who may be termed horticultural botanists, who are apt to look upon external characters as of paramount importance, and who ignore the natural relationships which ought to underlie every rational classification.

Groups of genera agreeing in the general arrangement of their organs of fructification are united together into *Tribes*, and these again into *Orders*. These are further united into *Groups*, *Cohorts*, or *Classes*, which are still larger and more comprehensive assemblages. Even in the construction of these larger assemblages, botanists exercise very much their individual judgment, but there is of course a continually increasing consensus of opinion as new discoveries are made, and the general stock of knowledge thus increased.

The classification I have adopted in this work is founded on that used in Le Maout and Decaisne's "Systematic Botany," but the subdivision of the genera of the Ferns is more in accordance with that of the "Synopsis Filicum."

The plants treated of here belong to the great group of flowerless plants known as Vascular Cryptogams; that is to say, they differ from all other flowerless plants such as Mosses, Fungi, Lichens, Seaweeds, &c., by having woody vessels (or—more correctly—closed fibro-vascular bundles) in their stems, and by possessing true roots. In their growth they all exhibit an alternation of a sexual with an asexual generation, the plant produced from the spore (the *prothallus*) being small and short-lived, and bearing true sexual organs. From the mutual interaction of these, a second plant is produced, which bears a distinct stem and leaves, grows usually for several years and produces a constant succession of spores.

Six orders of these Vascular Cryptogams are represented in New Zealand, and their most distinctive characters are here given in detail, their further subdivisions being specified in Chap. III.

Order I.—Filices (or Ferns). The distinctive characters of the true ferns are well marked, so that there is not much difficulty in recognizing them. The leaves or fronds are usually well developed, and expand in a circinate manner, being coiled up when young in the form of a crozier; they bear the spores either on their under-surface or on their edge. The sporangia or spore-capsules are collected into groups called *sori*, which are placed in certain relations to the veins, and are differently formed and situated in

different tribes. These capsules are usually oblong or orbicular, and furnished with a short stalk; while over them commonly passes a more or less complete *ring* or *annulus* (Pl. I. fig. 4*a*), which by its elasticity serves to rupture the capsule and liberate its contents. There is only one kind of spore. New Zealand contains 29 genera, including 124 species—a large number compared with Britain, which only has (according to Sir J. Hooker) 13 genera and 37 species.

Ferns are divided into eight tribes, of which seven are represented in New Zealand. Their characters will be found in the next chapter.

Order II.—Ophioglossaceæ is a small group, often included among true ferns, but differing from them in some important respects. The short subterranean rhizome sends up only one leaf, or at the most two or three, and these are not rolled up in the circinate manner characteristic of ferns. They take, also, a very long time to develop, those of *Botrychium* being four years of coming to maturity, of which three are spent underground. The spore-capsules are not collected into sori, but are arranged either in a spike or raceme-like cluster on a special fertile frond. They have no ring, and contain smooth triangular spores. Lastly, their prothallus, produced from one of these spores, is not a flat layer of cells, but a subterranean mass of cellular tissue, destitute of green colouring matter. Only three species belonging to this order occur in New Zealand.

Order III.—Marsileaceæ. All the plants of this order are aquatic or marsh-dwellers, and their fronds expand in a circinate manner like those of ferns. At the base of the fronds and near their creeping rhizome the organs of fructification are found. These organs are really formed from modified infolded leaves, and in our plant (*Pilularia*) are small oblong capsule-like bodies (the *sporocarps*), borne on short stalks and opening by 2 (or 4) valves. If cut transversely, these capsules are found to be 4-celled, or divided into 4 cavities, each cavity containing a number of oval or egg-shaped bodies. Those near the bottom of each cavity are termed *macrosporangia*, because each contains only one large spore, the *macrospore*. Those in the upper half of the capsule are *microsporangia*, and contain each from 20 to 30 most minute granules—the *microspores*. The latter are the male reproductive organs, while from the macrospore the prothallus is developed.

Only one plant belonging to the order has hitherto been found in the colony.

Order IV.—Salvinieæ. This is another order of aquatic plants, which is represented in New Zealand by a very common and extremely pretty little plant of the genus *Azolla*. In many parts of the colony it covers the water of lagoons and ditches with a green or reddish mantle, thus resembling the common duckweed. It floats on the surface of the water, and sends down numerous roots, which do not, however, attach themselves to the soil at the bottom. As in the last order (with which some botanists unite this), the reproductive organs are inserted near the base of the fronds. They are, however, different in structure, being only 1-celled, and containing one kind of sporangia arranged along a central column which stands up in the middle of the sporocarp. Thus one sporocarp contains macrosporangia only, in each of which is one macrospore. Other sporocarps contain only microsporangia, each containing a number of microspores. The prothallus is developed from the former.

Order V.—Lycopodiaceæ.(Club Mosses). These are distinguished from ferns and other allied plants by many characteristic features. They are all terrestrial, are furnished with dichotomously branching roots (except *Psilotum*, which has no true roots, and *Phylloglossum*, in which they are tuberous), and develop their branches very irregularly. The leaves are always small and 1-nerved, and in very many species are decurrent on the stems. The reproductive organs are contained in capsules or sporangia, which are usually solitary in the axils of particular leaves, but sometimes these fertile leaves are so crowded or imbricated together as to form the fructification into spikes. These sporangia are 1-celled (*Lycopodium*), 2-celled (*Tmesipteris*), or 3-celled (*Psilotum*), but contain only one kind of spores.

The process of development from the spore has been imperfectly observed in one species of *Lycopodium* only, and with this exception it may be said that there is no information on the subject as far as our New Zealand genera are concerned. Probably most botanists have at one time or another tried to become famous by studying the development of this order, but no one has succeeded up to the present in throwing light on the matter, so that there is still a magnificent field of research open in this direction to any enterprising student.

There are 4 genera and 14 species of the order in these islands.

Order VI.—Isoëteæ. This is a small order, consisting of a single genus (*Isoëtes*), which is included among Lycopods by many botanists. Though nearly allied to them, it has some very distinctive characters, which mark it at once. Most of the plants forming it are aquatic and submerged, living at the bottom of pools and lakes; a few are terrestrial. The leaves or fronds are grass-like, and have a well-developed sheath. This is hollowed out at the base into a pouch, which is surrounded by a narrow border, and has a scale or ligule above it. The pouch encloses a membranous sac, the *sporangium*, which is divided by transverse partitions into several compartments. All the sporangia appear externally similar, but those of the outer leaves are macro-sporangia, containing from 40 to 200 macrospores, while those of the inner leaves are micro-sporangia, and contain a vast number (probably over a million) of flour-like microspores. The prothallus develops from the former, while it is still ripening.

Two species of *Isoëtes* have been found in our lakes.

The only remaining group of the Vascular Cryptogams not yet mentioned is that of the *Equisetaceæ* or *Horse-tails*. These plants are tolerably familiar to all who have collected botanical specimens in England, but are not found at all in New Zealand; in fact, they are absent throughout nearly the whole of the Southern hemisphere.

CHAPTER III.

ENUMERATION AND SPECIFIC DESCRIPTION OF FERNS AND FERN ALLIES.

EVERYONE desirous of acquiring a correct knowledge of these interesting and beautiful plants should work out the ordinal and tribal characters, as well as those of the genera and species; but to do this satisfactorily requires the use of a good pocket lens, or, still better, of a simple dissecting microscope. Pocket lenses of all kinds are to be had, and at all prices, from one shilling to thirty; for the maximum amount of satisfaction I would recommend Browning's* platyscopic lenses (medium size). They are more expensive than ordinary glasses, but they possess the great advantage of bringing the objects out on a flat field instead of distorting them, as so many of the higher power lenses do. They can be carried in the waistcoat pocket attached to a thin silk or other cord, as from their small size they are apt to be lost when one is out scrambling after ferns. For examination of these plants at home, there is nothing equal to a dissecting microscope, and they can be had of very various make and price. Thus Mr. Browning advertises a cheap and useful instrument, "The Houston Microscope," furnished with three glasses and a pair of forceps, all for the modest sum of 6s. 6d. An excellent instrument is Swift's,* "Convenient Dissecting Microscope," with a circular glass top, and costing £2. Of more expensive instruments suitable for every description of dissecting work, I would instance Beck's* (price £5 10s., without accessory apparatus), and Swift's portable (price £6 10s.), the last a most convenient instrument for the traveller. But there are numerous other makers who turn out most excellent instruments. I consider the best dissecting tools to be 3-cornered needles, but as these cannot readily be obtained in the colonies, I employ short but stout ordinary needles, ground flat on two sides and fastened into short

* Messrs. James Swift and Sons, 43 University-street, London, W.C.; Messrs. R. and J. Beck, 31 Cornhill, E.C.; Mr. J. Browning, 63 Strand, W.C.

cedar-wood handles, about as thick as a penholder, and 3 or 4 inches long. Special needle-holders made of bone or ivory may be purchased from all microscope makers, but the simpler instrument will be found a very satisfactory substitute. A pair of good strong forceps completes the requisite apparatus. In examining a portion of a frond in the dissecting microscope, the piece should be placed on the slide of the glass table of the instrument in a drop of water; practise will enable the student to judge the exact amount of water required. Holding the fragment down with the left-hand needle, parts may be cut off, removed or turned in any direction with that in the right hand, the lens being focussed down to the right distance.

ORDER I.—FILICES (True Ferns).

THE arrangement of the genera adopted here is that of the "Synopsis Filicum," but the plants constituting the sub-order Ophioglossaceæ have been removed from among the true ferns and placed in a distinct order by themselves.

Tribe I.—Gleicheniaceæ. *Capsules solitary or grouped into small sori of a definite number* (2-6), *sessile, globose, completely girt by a broad, transverse or oblique ring, and opening vertically. No involucre.* (Pl. I. fig. 1.)

Rhizome creeping. Fronds rigid, coriaceous, mostly dichotomously branched; segments of the pinnæ small and round, or elongated and comblike ... 1. Gleichenia.

Tribe II.—Cyatheaceæ. *Sori globose, dorsal, formed of numerous capsules; these are either sessile or stalked on a somewhat elevated receptacle, and are often mixed with jointed hairs. They are obovate in form and somewhat compressed, and are furnished with a broad vertical or oblique ring.* (*The tree-ferns belong to this tribe.*) Pl. I. figs. 2-5.

I.—*Sori at or near the forking of a vein.*

Involucre globose and at first covering the whole sorus, afterwards breaking irregularly at the summit and leaving a cup with smooth or torn edges; large tree-ferns ... ... 2. Cyathea.

Involucre a scale (often indistinct) on the underside of the sorus; a large tree-fern ... ... 3. Hemitelia.

Involucre wanting; a small tree-fern ... 4. Alsophila.

II.—*Sori at the apex of a vein, just within the margin.*

Involucre a 2-valved cup; large tree-ferns 5. Dicksonia.

Tribe III.—Hymenophyllaceæ. *Sori on the extremity of a vein, and hence on the margins or apices of the frond or its segments. Capsule sessile, rounded or pear-shaped, attached usually by the centre to a filiform receptacle, which is often exserted; ring oblique or transverse completely surrounding the capsule, which therefore dehisces longitudinally; involucre 2-valved, or tubular. Most ferns of this tribe are small, and of a very thin, semi-transparent consistence, and many are epiphytes.* (Pl. I. figs. 6-8.)

Involucre tubular; mouth entire, contracted; capsules with a short, incomplete ring. Fronds coriaceous, opaque... ... ... 6. Loxsoma.

Involucres 2-lipped or 2-valved. Fronds thinly membranous ... ... 7. Hymenophyllum.

Involucre 2-lipped; mouth more or less 2-lipped; receptacle often considerably exserted. Fronds usually membranous 8. Trichomanes.

Tribe IV.—Polypodiaceæ. *Sori on the margins or back of the frond, with or without an involucre, and destitute of a raised or elongated receptacle. Capsules all stalked, furnished with an incomplete vertical ring, and bursting transversely. This is by far the largest family of ferns, and is divided into numerous groups.*

Section I.—Sorus with an involucre.

Family I.—Davallieæ. *Sori covered with a reniform or orbicular scale-like involucre, which is always open at its apex.* (Pl. I. fig. 9; and Pl. II. fig. 1.)

Involucre at the tip of a vein or segment, attached by its base and sides ... 9. Davallia.

Involucre in the middle of a vein, attached by its broad base only ... 10. Cystopteris.

Family II.—Lindsayeæ. *Sori in a line near the edge of the frond.*

Involucre opening outwards, the inner valve being membranous, the outer formed of the margin of the frond. (Pl. II. fig. 2.)... ... ... 11. Lindsaya.

Family III.—Pterideæ. *Sori oblong or linear, on the margins; involucres opening inwards, of the same shape as the sori, and formed of the more or less recurved margin of the frond.* (Pl. II. figs. 3–8.)

Sori oblong or reniform; involucre of a different texture from the rest of the frond. Segments of the frond usually 1-sided ... ... 12. Adiantum.

Sori globose, placed in the sinuses of the frond and covered by a pseudo-involucre formed of the green incurved (but unchanged) tip of the segments of the frond. Fronds usually 6 in. to 3 ft. high ... ... 13. Hypolepis.

Sori on the veins, at or near the tip, at first globose but afterwards continuous round the margins, which are reflexed over them. Fronds usually under 6 in. ... ... 14. Cheilanthes.

Sori in a continuous line within the margin; involucre opening inwards, at length recurved and exposing the sori. Fronds pinnate ... ... 15. Pellæa.

Sori continuous, marginal; involucre membranous, recurved. Fronds 2- or 3-pinnate ... ... 16. Pteris.

Fertile and barren fronds dissimilar. Sori linear, continuous, parallel with the midrib and filling the segment; involucre formed of the revolute membranous margin ... ... 17. Lomaria.

Family IV.—Blechneæ. *Sori oblong or linear, on the back of the frond, parallel with and distant from the margin of the segments. Involucre of the same shape as the sorus, opening towards the midrib.* (Pl. II. fig. 9.)

Sori on veins which form arches between the midrib and margins of the segments ... ... 18. Doodia.

Family V.—Aspleniеæ. *Sori linear (or oblong), attached to the veins, and placed obliquely to the midrib.*

Involucre membranous, fastened on one side to the vein, opening along the outer edge (Pl. III. figs. 1 and 2.) ... 19. Asplenium.

Family VI.—Aspidieæ. *Sori globose, on the back of the frond. Involucre globose or reniform, attached by a point at the centre or sinus.* (Pl. III. figs. 3–5.)

Involucre orbicular, fixed by the centre 20. Aspidium.

Involucre cordate-reniform, fixed by the sinus. Fronds pinnate or very compound ... ... 21. Nephrodium.

Involucre reniform, opening outwards, and attached by a broad base. Fronds pinnate ... ... 22. Nephrolepis.

Section II.—Sorus naked.

Family VII.—Polypodieæ. *Sori on the back of the frond rounded or rarely oblong, never more than twice as long as broad* (Pl. III. figs. 6–7.) ... 23. Polypodium.

Family VIII.—Grammitideæ. *Sori on the back of the frond usually linear, always more than twice as long as broad.* (Pl. III. figs. 8–9.)

Sori continuous within the margin of the frond, which is often partially recurved over them as a pseudo-involucre ... ... 24. Nothochlæna.

Sori on the veins, spreading over the under surface of the frond in simple or branched lines ... ... 25. Gymnogramme.

Tribe V.—Osmundeæ.

Capsules large, vertically 2-valved, furnished with a short transverse ring, not forming regular sori, but clustered irregularly on the back of the frond (Pl. III. fig. 10.) ... ... 26. Todea.

Tribe VI.—Schizæaceæ. Capsules 2-valved, opening down the side, crowned by a complete ring on the apex like a cap, arranged in spikelets. (Pl. III. fig. 11, and Pl. IV. fig. 1.)

Capsules sessile in 2 rows on one side of close spikes, which are pinnately-arranged at the apex of the fronds ... 27. Schizæa.

Capsules solitary in the axils of scales which form spikes, either on separate pinnæ or on the margins of the leafy ones. Stems widely-climbing ... 28. Lygodium.

Tribe VII.—Marattiaceæ. Capsules 6-12, united together into a boat-shaped sorus or synangium, which is placed near the end of a vein on the back of the frond. (Pl. IV. fig. 2.)

Fronds very large, 2-pinnate ... ... 29. Marattia.

Genus I.—GLEICHENIA,* *Smith.* (Pl. I. fig. 1.)

Rhizome creeping, wiry and rigid. Fronds usually dichotomously branched, with a terminal bud at each fork; branches forked or pinnate, sometimes whorled. Pinnæ deeply pinnatifid; segments small, concave and suborbicular, or pectinate with elongated lobes. Sori of 2-4 or 10-12, sessile capsules opening vertically, and girt by a broad, transverse, complete ring.

* In honour of Baron von Gleichen, a German botanist.

I.—Lobes of the pinnæ small, suborbicular. Sori solitary on the tip of the veinlets.

Lobes of the pinnæ flat or recurved. Sori exposed ... ... 1. G. circinata.

Lobes of the pinnæ pouch-like, concealing the sori ... ... 2. G. dicarpa.

II.—Lobes of the pinnæ linear. Sori on the middle or forks of the veinlets.

Lobes of the pinnæ serrulate, not glaucous below ... ... 3. G. flabellata.

Lobes of the pinnæ entire, glaucous below ... ... 4. G. cunninghamii.

III.—Stipes zigzag, repeatedly di- or tri-chotomous. Base of the forked branches with a pair of accessory pinnæ 5. G. dichotoma.

1. G. circinata, *Swartz.* (Pl. I. figs. 1-3.)

Fronds 1-3 ft. high; stipes and rachis glabrous or more or less chaffy, hairy or scaly; branches very narrow, 6-12 in. long, forked and pinnate. Pinnæ 1-2 in. long, very narrow; lobes ovate or semicircular, flat or recurved, green or glaucous beneath. Capsules 3-4, superficial.

Synonyms.—G. microphylla, *Br.;* G. speluncæ, *Br.;* G. semivestita, *Lab.;* G. rupestris, *Br.*

Distribution (outside New Zealand).—Tasmania, Australia, New Caledonia, Malacca and part of Polynesia.

This fern occurs abundantly throughout the northern part of the North Island, from N. Cape southwards, but becomes more local in the southern part. It is often found on newly-cleared ground. In the S. Island it is not so common, occurring sparingly along the line of the Southern Alps, Westland, Banks' Peninsula, along the E. of Otago, and both sides of Foveaux Straits. Also on the Chatham Islands. It is to be found (like the other N.Z. species of the genus) in rather poor, cold soil, either in open land or among low scrub, but never in dense bush.

All the *Gleichenias* are rather difficult to cultivate: this species thrives best in a mixture of loam, peat and sand, with plenty of water and good drainage.

2. G. dicarpa, *Br.*

Fronds erect, 3 in.-3 ft. high; stipes more or less woolly with brown pubescence, especially at the nodes; branches 2-12 in. long. Pinnæ ½-2 in. long, narrow; lobes round, pouch-like, coriaceous.

Capsules about 2, concealed within the lobes, and mixed with brown paleaceous hairs.

Var. *B. alpina.* Smaller and more tufted; usually more densely pubescent.

Synonyms.—G. alpina, *Br.;* G. vulcanica, *Blume;* G. hecistophylla, *A. Cunn.* (In the "Handbook to the N.Z. Fl." this var. is referred to *G. circinata.*)

Distribution.—Mountainous parts of Australia and Tasmania, New Caledonia, and some islands of the Malay Archipelago.

In N.Z. the range of this species is more restricted than the former, as it does not seem to have been collected N. of Auckland. It is tolerably common on the high lands surrounding L. Taupo, and from Hawke's Bay across to Taranaki, as well as at the Hot Spring district in the N., and throughout the Wellington Provincial district. In the S. Island both forms occur from Cook Straits to Stewart Island, but always locally. Also on the Chatham Islands.

Rather easier to cultivate than *G. circinata;* thriving best in well-drained vegetable mould.

3. G. flabellata, *Br.* (Pl. I. fig. 1*a*.)

Fronds usually 1-3 ft. high, but reaching 5-7 ft. in favoured localities, generally quite glabrous, membranous, very proliferous. Branches ascending, dichotomous, fan-like; pinnæ 4-12 in. long, often pinnatifid above, lanceolate, 1-3 in. broad; segments 1-2 in. long, inclined, narrow-linear, serrulate on the margins, green on both surfaces. Capsules about 3, exposed.

Distribution.—N. and S. Australia, Tasmania, and New Caledonia.

This graceful fern ranges in N.Z. from the North Cape to the Hauraki Gulf, Great Barrier Island being the most southerly habitat yet recorded. According to Mr. C. French ("Southern Naturalist," vol. i. p. 4) it is easily removed and transported to a distance without much risk, and is easily cultivated, requiring black sandy loam, good drainage, plenty of pot room, and abundance of water. Probably in the S. portion of our island it would require housing during the winter months. In Kew Gardens a plant of this species has attained a circumference of 12-13 ft., with fronds 4½ ft. high.

4. G. cunninghamii, *Heward.* (*The umbrella-fern.*)

Rhizome stout, creeping. Fronds erect, 1-2 ft. high, often proliferous, coriaceous; stipes, costa and rachis hairy and scaly beneath. Branches curving or spreading, dichotomous, fan-like; pinnæ 6-12 in. long, usually pinnatifid above, linear, often falcate, acuminate, ½-1

in. broad; segments $\frac{1}{3}$-$\frac{2}{3}$ in. long, linear, margins flat or recurved, quite entire, often glaucous below. Capsules 2-4, usually exposed.

Distribution.—Confined to New Zealand. (Near a S. African species, *G. umbraculifera*, Moore.) Tolerably common throughout the N. Island, from the Bay of Islands southwards, but occurring more locally in the S. Island. It becomes more abundant in the extreme south, and is common in Stewart Island.

This species is considered by Mr. T. H. Potts to be the most difficult of the N.Z. *Gleichenias* to cultivate.

5. G. dichotoma, *Willd.*

Fronds 2-6 ft. high. Stipes zigzag, repeatedly di- or tri-chotomous, the ultimate branches bearing a pair of forked pinnæ; a distinct pair of pinnæ also arises from the base of the forked branches (not of the frond). Pinnæ lanceolate, acuminate, pinnatifid; segments linear, obtuse or emarginate, glaucous below. Capsules 10-12, exposed.

Synonyms.—These are so numerous, owing to the number of localities from which this fern has been described, that a list of them would only serve to confuse the reader.

Distribution.—Almost universally distributed throughout the tropical and subtropical regions of both the New and Old Worlds, ranging as far north as Japan.

Only found in N.Z. in the Hot Spring district, where it is abundant in several localities, as at Rotomahana, Orakeikorako, and round L. Taupo, where it thrives best among the sulphurous vapours. It has also been gathered at Matata in the Bay of Plenty. This is the fern mentioned in the "N.Z. Handbook," p. 348, as having been erroneously introduced by Forster among his New Zealand plants. Mr. Kirk has pointed out that probably Forster gathered it at some isolated locality in the Bay of Plenty or Poverty Bay, but that his inclusion of it among the plants used by the Maories as food is apparently an error.

In the S. Island this plant requires indoor cultivation, and the remark probably applies to the greater portion of the N. Island also. Mr. J. Smith, formerly curator of the Royal Botanic Gardens, Kew, recommends the growth of all the species of *Gleichenia* in shallow pans or boxes, as, in all, the rhizome creeps at only a short distance below the surface of the ground.

Genus II.—CYATHEA,* *Smith.* (Pl. I. fig. 2.)

Tree-ferns. Fronds bi- or tri-pinnate. Sori on the veins, or in the axil of the forking of a vein, distant from the margin, globose. Involucre inferior, globose, covering the whole sorus, afterwards bursting irregularly at the summit, forming a more or less persistent

* Gr. *Kyathos*, a cup, from the cup-shaped indusium.

cup. Capsules numerous, crowded on an elevated receptacle, usually half-girt with a broad vertical elastic ring.

Frond white and glaucous below ... 1. C. dealbata.
Frond not white nor glaucous below.
Frond coriaceous; costa glabrous above, tubercled below... ... 2. C. medullaris.
Frond flaccid, membranous; costa with short stiff hairs above, scabrous below ... ... 3. C. cunninghamii.

1. C. Dealbata, *Swartz.* (*Ponga; silver tree-fern.*)

Trunk slender, almost black, 10-40 ft. high. Fronds 6-12 ft. long, bipinnate, slightly coriaceous, dark-green above, white underneath from the presence of a deciduous powder. Stipes, rachises and costæ with pale-brown deciduous tomentum; primary divisions 1-1½ ft. long; pinnæ 2-4 in. long, linear-lanceolate, acuminate or caudate, deeply pinnatifid or pinnate below; lobes close-set, linear-oblong, more or less falcate, serrate. Sori numerous; involucre membranous, breaking irregularly, leaving usually an orbicular cup.

Distribution.—Lord Howe's Island (to the N.W.); Chatham Islands (to the E.)

This is one of the most beautiful and common tree-ferns in New Zealand, ranging from the North Cape to Foveaux Straits. In the S. Island it is rather local on the W. Coast, but abundant on the East. It has not been recorded from Stewart Island. It is only to be found in the shelter of the forests, where alone all the *Cyatheas* and *Dicksonias* are to be looked for.

2. C. medullaris, *Swartz.* (*Mamuka; Black-fern.*)

Trunk 10-40 ft. high, stout, conical, black, densely fibrous. Fronds very numerous, 10-20 ft. long, bi- or tri-pinnate, coriaceous, dark-green above, pale below; stipes and rachis covered with short spinous tubercles; secondary pinnæ 4-6 in. long, ¾-1¼ in. broad, acuminate, pinnatifid above, pinnate below; segments ½ in. long, oblong or linear, falcate, obtuse or acute, lobulate or sub-pinnatifid in fertile, serrate or entire in barren specimens. Sori arranged singly on each lobe of the segment, the margin of which is usually revolute. Involucral cup with an irregular or 2-lobed margin.

Synonyms.—Polypodium medullare, *Forst.*; C. milnei, *Hook.* (variety from Kermadec Islands); C. polyneuron, *Col.* (var.)

Distribution.—S.E. Australia (Baron F. von Mueller), Kermadec Islands, Chatham Islands.

This splendid fern is found from North Cape to Stewart Island. It is common on the West Coast of the S. Island and throughout the forests of the N. Island, but is rare along the East Coast of

Otago, and has not apparently been gathered in the E. of Canterbury. At the Thames it ascends to 2,000 ft. The Maories still eat the mucilaginous pith (from which the specific name is derived), and also prepare a thick syrup from it. As the trunks are very useful for house-building, fencing, road-making, &c., the plant runs a great risk of being exterminated in time. In humid districts it stands transplantation well, and therefore ought to be easily cultivated, if suitable means are adopted to keep the surrounding atmosphere sufficiently moist.

3. C. cunninghamii, *Hook. f.*

Trunk 10-15 ft. high, more or less fibrous and scarred with the bases of old fronds. Fronds numerous, 6-9 ft. long, tripinnate, flaccid and membranous, acuminate; stipes and rachis pale, furnished with scales and long brown hairs, slightly tubercled, costæ with short, stiff hairs; primary pinnæ 1-2 ft. long; secondary pinnæ 2-5 in. long, ¾-1 in. broad, oblong, acuminate, pinnatifid at the apex; segments ½ in. long, linear, pinnatifid, lobes entire. Sori small, solitary on each lobe; involucre very thin, breaking down very irregularly into a shallow cup, sometimes remaining as a scale on the underside (as in the genus *Hemitelia*).

I follow Sir J. D. Hooker and Baker in retaining this fern as a distinct species; probably it ought to be reduced to the rank of a variety of *C. medullaris*, from which it is, however, easily distinguished by habit and a few very unimportant characters.

It appears to be confined to the North Island, where it ranges from Bay of Islands to Cook Straits.

Genus III.—HEMITELIA,* *Br.* (Pl. I. fig. 3.)

Tree-ferns. Fronds large, pinnate or decompound. Sori globose, dorsal on a vein or veinlet. Receptacle elevated. Involucre a scale—often very deciduous—situated on the underside of the sorus.

(A genus not easily distinguished from *Cyathea*, and intermediate between it and *Alsophila*.)

1. H. smithii, *Hook.*

Trunk 10-20 ft. high, covered with fibres, and rough with the persistent bases of old fronds. Fronds 8-9 ft. long, bipinnate, bright pale green; stipes stout, clothed at the base with stiff subulate brown scales, 1-1½ in. long; rachis pale, glabrous and smooth except at the tips, which—with the costæ—are furnished with very short, stiff hairs; primary pinnæ 12-15 in. long, 4-5 in. broad; secondary pinnæ 2-2½ in. long, pinnate below, pinnatifid above; segments linear-oblong, acute, falcate, serrate or crenate. Sori on the forks of the veins; involucre hemispherical.

* Gr. *Hemiteles*, half-finished, from the imperfect involucre.

Synonym.—Cyathea Smithii, *Hook. f.* ("Handbook N.Z. Fl.," p. 350.)

A most abundant tree-fern, ranging in the North Island from the Bay of Islands to Wellington, and ascending to 3,000 ft. In the South Island very common, as far south as Foveaux Straits. This species stands transplantation very well, and is an easily-cultivated fern, requiring a rather shaded spot and considerable depth of soil. It should be found in every good fernery.

Genus IV.—ALSOPHILA,* *Br.* (Pl. I. fig. 4.)

Small tree-ferns. Fronds large, bi- or tri-pinnate. Sori globose, dorsal, on a vein or in the forking of a vein; involucre wanting; receptacle more or less elevated.

1. A. colensoi, *Hook. f.*

Trunk 2-5 ft. high (rarely as much as 7 ft.), suberect or prostrate, and sometimes buried almost to the crown. Fronds bipinnate, 2-4 ft. long, 10-20 in. broad, membranous; stipes densely clothed at the base with subulate white scales ½-1 in. long; the rest of the stipes, rachises and costæ with numerous brown hairs and tumid fimbriate scales; primary pinnæ 12-14 in. long, oblong-lanceolate, acuminate; secondary pinnæ 1½-2 in. long, acuminate, rather distant, deeply pinnatifid; lobes oblong, obtuse, serrate. Sori numerous, prominent, situated on the middle of the veins.

This, the hardiest of our tree-ferns, occurs chiefly in elevated and somewhat exposed districts. In the N. Island it is found in the hilly country of the interior at elevations of 1,500 to 2,500 ft. It occurs in the S. Island in various parts of Canterbury province, as at Malvern Hills, Banks' Peninsula, &c. In Otago it is very local, occurring abundantly on Flagstaff Hill, near Dunedin; also at Catlin's River, Lake Wakatipu, and near Invercargill.

An easily-cultivated species, requiring as little care as any, and not particular as to the amount of sunshine it receives.

Genus V.—DICKSONIA,† *L'Heritier.* (Pl. I. fig. 5.)

Tree-ferns. Fronds large, bi- or tri-pinnate. Sori globose, at the apex of a vein, just within the margin. Involucre inferior, subglobose, 2-valved; inner valve coriaceous, outer formed of the recurved concave tooth of the pinnule. Receptacle elevated; capsules half-girt with an incomplete vertical ring.

Trunk tall, black. Stipes tubercled, black.
Sori large, 6-8 on each segment,
completely filling it up ... ... 1. D. squarrosa.

* Gr. *Alsos*, a grove; *phileo*, to love.
† In honour of James Dickson, a British cryptogamic botanist.

Trunk tall, brown. Stipes smooth, pale-brown. Sori rather small, 4-5 on each segment ... ... 2. D. antarctica.

Trunk short or O. Stipes smooth, pale. Sori rather large, 6-10 on each segment, filling it up ... ... 3. D. lanata.

1. D. squarrosa, *Swartz.*

Trunk 10-20 ft. high, slender, black or dark brown, clothed with the persistent bases of old fronds. Fronds few, bi- or tri-pinnate, 6-10 ft. long, oblong-deltoid, very coriaceous. Stipes black, tubercled, densely covered with soft spreading hairs intermingled with scales ¼-1 in. long; primary pinnæ 10-30 in. long, 4-6 in. broad; secondary 3-4 in. long, ½-¾ in. broad, linear, sessile or stipitate; segments lanceolate-oblong, rigid, sterile toothed, fertile deeply pinnatifid. Sori large, 6-8 on a segment.

Synonyms.—Trichomanes squarrosa, *Forst.*; Dicksonia fibrosa, *Col.*; D. intermedia, *Col.*

Mr. Kirk remarks on D. fibrosa, *Col.*, which he makes a variety of D. squarrosa:—"This differs from ordinary forms of the Australian and Tasmanian plant in its smaller size, hairy rachis, more compact habit, and less coriaceous texture, but these are not characters on which specific distinctions can be based." ("N.Z. Inst. Trans.," vol. x. app. p. 43.)

This species occurs in the Chatham Islands, but does not range outside the N.Z. region. It occurs abundantly in both islands, from the extreme north to Stewart Island. The facility with which it is cultivated renders it a favourite plant with fern growers in other parts of the world, and, probably, were it not so common here, it would be more grown than it is. In Otago it occurs in bush and scrub from sea-level to 1,500 ft., and in Auckland province (at the Thames) up to 2,000 ft.; so that it is a hardy species, and stands frost and snow better than it does a burning sun.

2. D. antarctica, *Lab.* (*Weki-ponga* of the Maories.) (Pl. I. fig. 4.)

Stem 10-20 ft. high, stout, 1-1½ ft. diam., and densely clothed with matted brown fibres. Fronds usually bipinnate, 4-10 feet long, spreading, broadly lanceolate, coriaceous; stipes very short, smooth; rachis and costæ more or less pilose; primary divisions 5-10 in. long, 1½-2 in. broad, narrowed into long points; secondary pinnæ ¾-1 in. long, sessile, linear, acute; segments oblong, acutely toothed. Sori 4-6 on each segment.

D. sparmanniana, *Col.*, has a very short stem, only rising a few inches above the ground, obovate or cuneate fronds, and about four small sori on each segment, in this and other respects resembling var. *fibrosa*. It occurs in hilly, shaded forests on the western slopes of

Ruahine Range, at the head of the river Manawatu (Colenso, "Trans. N.Z. Inst.," vol. xii. p. 363).

Distribution.—Tasmania and Eastern Australia, where it grows to a height of 30-40 ft., and with a trunk 4 ft. in diameter. Apparently also in New Caledonia.

In N.Z. the species is more limited than *D. squarrosa*, apparently not occurring north of Tauranga, on the E. Coast, or Ngaruawahia, on the W. Coast of the North Island. In the interior of the island, however, it is common, and is abundant in the forests of the South Island, where it ascends to a height of 3,000 ft.

It is an easily-cultivated species, and is one of the commonest tree-ferns to be found in the fern-houses of European and American cultivators.

3. D. lanata, *Col.*

Stem wanting or short, not exceeding 4-5 ft. high, covered with the bases of old fronds, but without matted root fibres. Fronds 1-7 ft. long, bi- or tri-pinnate, very coriaceous, broadly lanceolate or elliptical; stipes very long, furnished at the base with long dense purplish hairs; rachis glabrous; primary pinnæ 6-12 in. long, oblong, acuminate; secondary 1½-3½ in. long, linear, acuminate; segments broadly oblong, obtusely toothed. (The fertile pinnæ are narrower than the barren, and are often pinnate again, while the others which have the segments deltoid in form are only lobed or pinnatifid.) Sori crowded, 6-12 on each segment, filling up the whole of it except the midrib.

Synonym.—D. lævis, *Heward.*

This species is confined to the forests of New Zealand. It is common in the north of Auckland province, where it is usually furnished with a short trunk, while to the south it assumes the stemless habit. It is very local in its distribution, occurring in several localities in the Taupo district, at Cape Colville, at the Thames at elevations of 1,200-1,800 ft., and probably throughout the interior of the North Island. It is also found in the South Island, along the W. Coast as far as Okarita, and down the E. Coast to Banks' Peninsula, where, however, it is by no means common.

Genus VI.—LOXSOMA,* *Br.* (Pl. I. fig. 6.)

Rhizome stout, woody, creeping. Fronds erect, coriaceous, 3-pinnate, opaque. Sori marginal, in the sinus of the teeth or lobes, terminating a vein, inclined backwards. Involucre urceolate, coriaceous; mouth entire, truncate. Capsules pedicelled, with a short broad incomplete oblique ring, opening vertically. Receptacle elongate, much exserted, furnished with jointed hairs among the capsules.

* Gr. *Loxos*, oblique; *soma*, a band, referring to the ring of the capsule.

1. L. cunninghamii, *Br.*

Rhizome covered with long, curved, red-brown hairs. Fronds 1-2 ft. high, broadly triangular, bright-green above, usually white or glaucous below; stipes (long) and rachis glabrous, polished; pinnæ ascending, lower opposite; pinnules lanceolate, again pinnate or pinnatifid; segments linear-oblong, subacute, notched.

"A remarkable fern, with the habit of a coriaceous *Dicksonia;* the fructification rather of *Trichomanes*, but with a very short and oblique ring to the capsule."—("Syn. Fil.," p. 56.) This beautiful and interesting species is the only one of the genus, and is not only confined to New Zealand, but is very local and restricted in its distribution, occurring in woods in the N. Island only, as far south as the Thames. It is to be found at various localities near Auckland, also at Coromandel, Wangarei, Bay of Islands and Great Barrier Island where it ascends to 1,000 ft.

There are two very slightly differing varieties, one having the under surface of the frond glaucous or silvery, and the other with both surfaces of an uniform olivaceous green colour.

Genus VII.—HYMENOPHYLLUM,* *L.* (*Filmy-ferns.*)
(Pl. I. fig. 7.)

Ferns usually furnished with a slender, wiry, creeping rhizome, growing on the trunks of trees and damp rocks. Fronds mostly of a delicate membranous texture, more or less pellucid; pinnate or 2- or 3-pinnatifid. Sori axillary or terminal, more or less sunk in the frond or exserted, terminating a costa or vein. Involucre more or less deeply 2-valved, membranous; lips toothed or entire, opening outwards. Receptacle elongated, exserted or included. Capsules mostly orbicular, depressed, girt by a complete, broad transverse ring, opening irregularly at the apex.

The beautiful and delicate ferns belonging to this genus owe their filmy appearance to the fact that the tissue of their fronds is composed (as in mosses) of a single layer of cells. In cultivating them, therefore, it is necessary to protect them from the wind as well as the sun, and also from the dry air of most rooms. They are usually grown under bell-glasses or in cases specially constructed for them, as the atmosphere they thrive best in is too moist for most other ferns, and they should be placed in a shady spot. In their native habitats they grow frequently in a continual drip, and indoors they like something as near that as possible—a sort of perpetual steam-bath—but in this respect there is considerable variability, some species being much hardier than others. A loose, fibrous, somewhat sandy soil with good drainage suits them best.

The accompanying artificial key to aid in the identification of the species is essentially the same as that in Hooker's "Handbook to the N.Z. Flora," p. 352.

* Gr. *Hymen*, a membrane, and *phyllon*, a leaf.

I.—Fronds glabrous; margins toothed.

Fronds 1-3 in. long, pinnate. Sori supra-axillary ... ... 1. H. tunbridgense

Fronds ½-2 in. long, pinnatifid. Sori solitary, terminal on the main rachis, free ... ... 2. H. minimum.

Fronds minute, $\frac{1}{6}$-$\frac{3}{4}$ in. long, simple or digitately-forked. Sori 1-3, terminal on the segments ... 3. H. cheesemanii.

Fronds 2- or 3-pinnatifid, ovate-deltoid. Invol. sub-orbicular, divided nearly to the base. Receptacle always included ... 4. H. bivalve.

Fronds 3-pinnatifid, ovate-lanceolate. Invol. obovate, tubular below, divided not more than half-way down. Receptacle often exserted ... ... 5. H. multifidum.

II.—Fronds glabrous, or with hairs on the stipes, rachis and costa only (except in No. 16); margins entire.

* *Fronds pinnatifid; stipes and rachis more or less winged throughout.*

Stipes filiform. Frond pendulous, flat, very delicate, 2-pinnatifid. Invol. large, broad, compressed, terminal, on the segments of the upper pinnæ ... ... 6. H. rarum.

Fronds 3-pinnatifid, rather opaque, reddish; rachis glabrous; segments linear, flat or concave; sori terminal or axillary, free; invol. broad, ovate .. .. 7. H. polyanthos.

Fronds 3- or 4-pinnatifid, opaque; rachis villous; segments long, narrow-linear; sori always terminal, free; invol. broad, orbicular ... ... 8. H. villosum.

Fronds 3-pinnatifid; stipes, rachis and segments crisped or wavy; sori terminal or axillary, free; invol. broad, orbicular ... ... 9. H. javanicum.

Fronds 2-pinnatifid dull-green; segments linear; sori terminal, free; invol. narrow, lips deeply toothed ... ... 10. H. montanum.

Fronds tall, 3-pinnatifid. Sori terminal or axillary, half-sunk in the frond; invol. opening halfway down ... ... 11. H. dilatatum.

Fronds tall, broad, 3- or 4-pinnatifid. Sori terminal or axillary, free; invol. orbicular, divided nearly to the base ... ... 12. H. pulcherrimum.

** *Fronds pinnate below. Stipes not winged. Rachis winged above only.*

Stipes and rachis glabrous. Fronds bright-green. Invol. ovate ... 13. H. demissum.

Stipes and rachis bristly. Fronds dark-green. Invol. orbicular ... 14. H. scabrum.

Stipes woolly at the base only; rachis glabrous. Fronds pale-green, glistening... ... ... 15. H. flabellatum.

Stipes, rachis and costæ sparingly hairy. Invol. small, terminal, half-sunk in the frond; hairy when young ... ... 16. H. rufescens.

III.—Fronds ciliated, and covered with brownish stellate pubescence.

Fronds oblong, acuminate, with a broad central undivided portion; rachis broadly winged above and ciliated. Sori terminal, sunk in the frond ... ... 17. H. ciliatum.

Fronds pendulous, ovate-lanceolate, divided nearly to the rachis; rachis slightly winged above. Sori terminal, sunk in the frond 18. H. subtilissimum.

Fronds rigid, erect, linear-oblong, everywhere covered with dense pale tomentum; rachis quite free. Sori terminating the segments; lips of invol. shaggy ... 19. H. malingii.

1. H. tunbridgense, *Smith.*

Quite glabrous, tufted or matted. Rhizome slender, wiry. Fronds 1-3 in. long, oblong-lanceolate or linear, pinnate; pinnæ pinnatifid; segments linear, toothed. Involucre usually solitary, axillary, suborbicular, compressed, free or sunk in the segments; lips toothed or entire—

A. tunbridgense, Sm. (proper). Segments rather close; involucre sunk in the segments. (H. zeelandicum, *V. den Bosch;* here also must be referred H. pusillum, *Col.*)

B. unilaterale, Willd.—Pinnæ with few segments, which are pinnatifid on the upper side only; involucre free, lips entire. (H. wilsoni, *Hook.;* H. cupressiforme, *Lab.;* H. revolutum, *Col.*)

The synonyms of this species are so numerous that it is quite unnecessary to recapitulate them; the above being the most familiar. The two chief forms are readily distinguished, but the intermediate gradations are so numerous that it is next to impossible to fix on any distinctive characters of sufficient importance to be considered specific.

Distribution.—In most humid, temperate, and sub-tropical parts of the world. Both forms occur in Britain.

In N.Z. it ranges from the N. Cape to Stewart Island, and at all elevations from sea-level to 3,000 ft.; var. *B.*, though having the same range as *A*, is more local, and is not so common.

2. H. minimum, *A. Rich.*

Rhizome filiform, wide-creeping; stipes filiform, $\frac{1}{4}$-$\frac{1}{2}$ in. long. Frond $\frac{1}{2}$-$\frac{3}{4}$ in. long, pale-green, broadly ovate or deltoid, pinnate below, pinnatifid above; pinnæ and segments entire or cut into linear obtuse lobes, which are ciliate-toothed. Sori solitary, terminating the main rachis only; involucre free, stipitate, obovate-cuneate; lips short, toothed.

The solitary sorus is the most distinctive character of this pretty little fern, which ranges outside of New Zealand only to the Auckland Islands. In the N. Island it occurs in the neighbourhood of Cook Strait, being "partial to shaded rocks near the sea;" and it has also been recorded from Wangaroa, in the extreme north of Auckland peninsula. In the South Island it is much more abundant, though not very common, being found along both the E. and W. Coasts, ascending in Otago to 3,000 ft.

I cannot see by what characters *H. pygmæum*—described by Mr. Colenso (in "N.Z. Inst. Trans.," vol. xiii. p. 376)—is to be separated as more than a variety from this species.

3. H. cheesemanii, *Baker.*

A most minute tufted species, with filiform wide-creeping rhizome. Stipes filiform, $\frac{1}{6}$-$\frac{1}{4}$ in. long. Frond $\frac{1}{6}$-$\frac{3}{4}$ in. long, simple, forked or palmately 3- or 4-fid; segments linear-oblong or ligulate, obtuse, one-veined, strongly ciliate-toothed on the margins. Sori 1-3 to a frond, terminal on the segments; involucre orbicular, immersed at the base only, valves rounded, entire, much exceeding the very short tube.

This miniature species has been found in the North Island among moss on trees at Whangarei, Great Barrier Island, Hunua, Titirangi,

and the Thames goldfields, and always above 500 ft. elevation. In the South Island, on rocks on the Upper Waimakariri, Bealey, Arthur's Pass, and several other localities on the Canterbury Alps; while on the West Coast it occurs at Okarita (the most southern locality yet recorded) and Hokitika; its range is from sea-level to 4,000.

To this species must apparently be united H. armstrongii, *Kirk* (Trichomanes armstrongii, *Baker*), which is only to be distinguished—according to Mr. Kirk—by its firmer texture and stout marginal nerve, both of them characters which do not appear to be always constant. A figure of this appears in "N.Z. Inst. Trans.," vol. x. p. 394.

4. H. bivalve, *Swartz.*

A matted, glabrous species, with stout, wiry, creeping rhizome. Stipes 2-4 in. long, wiry, naked. Frond 3-8 in. long, dark-green, broadly-ovate or triangular, 2- or 3-pinnatifid; main rachis slightly winged above; secondary rachis winged throughout; lower pinnæ triangular, acuminate; ultimate segments linear, deeply toothed. Sori very numerous, terminal; involucre broadly ovate or subor-bicular, entire, divided nearly to the base, which is sunk in the frond; receptacle always included.

Synonyms.—H. spathulatum, *Col.*; H. pyriforme, *V. den Bosch*; Trichomanes bivalve, *Forst.*; T. pacificum, *Hedw.*

Distribution.—Confined to N.Z. and the Chatham Islands.

In the S. Island this species is common in the bush, ranging in Otago from sea-level up to 3,000 ft. In the N. Island it occurs commonly along the S. and E. Coasts, and in the hilly districts of the interior, but appears always to occur at considerable elevations, 2,000 ft. being about the average level. Thus at the Thames it has been gathered at 1,500-1,900 ft., on Pirongia at 2,700 ft. and Mt. Tarawera at 3,000 ft. At Cape Colville, according to Mr. Kirk, it does not occur below 2,000 ft. Apparently it has never been gathered about Auckland, or on the peninsula to the N. of it.

This is one of the most water-loving species of the genus, being frequently found—and in the greatest luxuriance—in the drip of a waterfall or on the rocky banks of forest streams. This fact is worth remembering in cultivating it.

5. H. multifidum, *Swartz.*

A matted glabrous species. Stipes 2-4 in. long, wiry, naked. Fronds 2-6 in. long, ovate-lanceolate, tri-pinnatifid; rachis hardly winged above; pinnæ broadly lanceolate; ultimate segments linear, very sharply toothed. Sori rather numerous, terminal on the lateral segments of the upper pinnæ; involucre quite free, obovate, tubular below; valves divided not more than half-way down, lips entire; receptacle often exserted.

Nearly allied to *H. bivalve*, but distinguished by the shape of the involucre, the frond being usually narrower at the base, the sori fewer, and the usually exserted receptacle.

Synonyms.—H. feejeense, *Brack.*; Trichomanes multifidum, *Forst.*

Distribution.—Islands of the Pacific; Auckland Islands; Campbell Islands.

A common and widely-ranging species, occurring throughout the N. and S. Islands up to 3,000 ft., and also abundantly in Stewart Island.

6. H. rarum, *Br.*

A very delicate pendulous species, forming matted tufts on stems of trees and rocks. Stipes 1-3 in. long, extremely slender. Frond 2-6 in. long, 1-2 in. broad, oblong or linear-oblong, 2-pinnatifid, flaccid, pale-green and glistening; main rachis winged throughout; pinnæ simple and linear, or forked or pinnatifid; segments short, broad, flat, margins not toothed. Sori large, terminal on the segments of the upper pinnæ and sunk in their extremities; involucre ovate or rounded, valves divided half-way down or more, lips broad, entire.

Synonyms.—H. semi-bivalve, *Hook. and Grev.*; H. fumarioides, *Bory.*; H. imbricatum, *Col.*; H. natalense and tabulare, *V. den Bosch.*

Distribution.—Auckland Islands, Tasmania, Mauritius, and S. Africa. Apparently also in Chiloe, Fuegia and Japan.

H. imbricatum of Colenso is a variety with a very short rachis, not more than 1 in. long, and imbricated, slightly crisped pinnæ.

This species ranges from the extreme N. of Auckland peninsula to Otago, and is tolerably abundant. In the Thames district it ascends to 2,500 ft.

This fern is rather difficult to cultivate, as it is usually found on tree-fern and other stems, its rhizomes creeping along under the bark or among the matted fibres; in transplanting, therefore, it is almost necessary to bring its support away with it.

7. H. polyanthos, *Swartz.*

A matted species with rather stout rhizome. Stipes 2-3 in. long, slender, glabrous or bristly; wing narrow or O. Fronds 2-8 in. long, 1-3 in. broad, broadly-ovate or oblong, rather opaque and reddish, 2- or 3-pinnatifid; main rachis usually broadly winged; segments linear, flat or wavy, ultimate short, quite entire. Sori numerous, terminal or axillary on the segments, free; involucres orbicular or ovate, broader than the segments, 2-valved to the base, valves entire or denticulate.

Synonyms.—H. protrusum, *Hook.*; H. sanguinolentum, *Swartz.*

Distribution.—A very common and wide-spread tropical and subtropical fern, occurring in America (in Cuba and Jamaica, Brazil, S. Chili and Juan Fernandez); in Asia (in India, Ceylon, the Malay Peninsula and Java); and in W. tropical Africa, Madagascar and Mauritius. It has not, however, been recorded from Australia.

In New Zealand it is an abundant species and is common throughout, from N. Cape to Stewart Island. At the Thames and on Pirongia it is common at 2,700 ft., and in Otago ranges from near sea-level to about 3,000 ft.

Swartz's name for this fern was given on account of the peculiar and disagreeable odour it emits when drying, and also from its reddish colour.

8. H. villosum, *Col.*

Rhizome wiry, creeping on rocks and trees. Stipes 1-2 in. long, with or without a narrow wing, villous. Fronds 2-5 in. high, 1-2 in. broad, opaque, dull brownish-green, broadly ovate or ovate-acuminate, villous, 3-pinnate; main rachis narrowly winged, flexuous; primary and secondary pinnæ deltoid, tertiary twice or thrice divided into narrow linear forked segments. Sori terminal and axillary, free; involucres as broad or broader than the segments, 2-valved to the base; valves entire.

Distribution.—Confined to New Zealand, where it has been recorded from the following localities:—N. Island: Ruatahuna, and summit of Tarawera, both localities lying in the mountainous region between Hawke's Bay and Bay of Plenty. South Island: Mountains of the Amuri, Nelson, 3-4,000 ft.; Broken River, Upper Waimakariri and Arthur's Pass, 2-3,000 ft., and Ashburton, in the Canterbury district; Okarita, on the W. Coast, the lowest altitude at which it has been observed; the Routeburn and mountains above Lake Harris, 4,000 ft.

Mr. Kirk, from whose paper (in the "N.Z. Inst. Trans.," vol. x. p. 395) I have quoted the above information, considers that this species is probably common throughout the colony at elevations above the highest limit of *H. polyanthos*, although but rarely occurring below.

In the "Handbook to the N.Z. Flora," this is treated as a variety of *H. Polyanthos*, but its claim to specific distinctness appears to have been well established.

9. H. javanicum, *Spreng.*

Tufted or matted; rhizome glabrous, wiry and creeping. Stipes 2-4 in. long, erect, margined above with a broad crisp wing. Frond 4-8 in. long, 3-4 in. broad, triangular, 3-pinnatifid, dull-green; main and secondary rachises bordered throughout with broad crisped wings; lower pinnæ 1½-2 in. long, deeply pinnatifid; segments narrow-linear, quite entire, more or less crisped. Sori numerous, terminal or axillary on the segments on both sides; involucre free,

ovate or orbicular, as broad or broader than the segments; valves divided to the base, lips entire or denticulate.

Synonyms.—H. crispatum, *Wallich;* H. fimbriatum, *J. Sm.;* H. flexuosum, *A. cunn.;* H. flabellatum, *Br.* (not *Labill.*); H. dædalum and H. erosum, *Blume;* H. reinwardii, H. micranthum, and H. tasmanicum, *V. den Bosch.*

H. atro-virens, *Colenso,* is a variety only, in which the segments of the frond are nearly plane, and the involucres rather narrower than the segments.

Distribution.—India, Ceylon, Malay Peninsula, Philippine Islands, Australia, Tasmania, and E. to the Chatham Islands.

This species ranges widely in New Zealand, but is rather local in its occurrence. It occurs in many localities to the north of Auckland, in the islands to the east, and in the forest region of the interior, down towards Wellington. At the Thames it is common at an elevation of about 1,500 ft. In the South Island it occurs sparingly along the eastern side of the central ranges, as at Rakaia Gorge, Malvern Hills, &c.; more common near Dunedin; while in the dense forests of the West Coast of Otago it is abundant, and ascends to over 2,000 ft.

10. H. montanum, *Kirk.*

Rhizome slender, wiry, creeping. Stipes about 1 in. long, winged nearly to the base. Fronds few, 2-3 in. long, glabrous, linear-oblong or oblong-lanceolate, bi-pinnatifid, dull-green; rachis flexuous, winged; pinnæ in from 5-8 pairs, mostly alternate, spreading, about ⅓ in. long, cut nearly to the rachis into 2-4 spreading, linear, forked or bilabiate segments. Involucres terminating the segments, small, oval, 2-lipped nearly to the base; lips deeply toothed or jagged, receptacle included.

This very recent addition to the New Zealand Hymenophyllæ was gathered on the mountains at the head of Lake Wakatipu. I have not seen the plant, and have therefore given Mr. Kirk's description in its entirety. The description and figure occur in the "N.Z. Inst. Trans.," vol. x. p. 394.

The species differs from the others of the same section in its narrow involucres, with deeply toothed or jagged lips.

Mr. Armstrong ("N.Z. Inst. Trans.," vol. xii. p. 346) suggests this as a variety of *H. tunbridgense,* but apparently without any reason, and reports it as occurring locally in the Canterbury Alpine district.

11. H. dilatatum, *Swartz.*

A very large, handsome, sub-erect fern, with a long, stout, wiry, and glabrous rhizome. Stipes 2-6 in. long, erect, wiry, winged above. Fronds bright-green, 6-18 in. long, or even as much as 30 in. in very fine specimens, 4-6 in. broad, ovate or ovate-lanceolate, 3-pinnatifid; main rachis winged throughout; lower pinnæ ovate-lanceolate,

divided nearly to the rachis, often cuneate at the base; secondary pinnæ again pinnatifid; ultimate segments linear, obtuse, entire. Sori numerous, terminal and axillary, somewhat sunk in the segments; involucres orbicular, divided more than half-way down; valves entire; clusters of capsules often exserted.

Synonyms.—H. formosum, *Brack.;* H. Junghuhnii and H. eximium, *V. den Bosch;* Trichomanes dilatatum, *Forst.;* Leptocionium sororium, *Presl.*

Distribution.—Java, Tahiti, Samoa, Aneitum, Fiji, and other Polynesian Islands; also found in the Chatham and Auckland Islands. It is very nearly allied to H. fuciforme, *Sw.*, a species occurring in South Chili and Juan Fernandez.

This is a very common fern in New Zealand, wherever there is any extent of moist bush. It is to be found from N. Cape to Stewart Island, ascending at the Thames to 2,500 ft., and in Otago to about 3,000 ft.

12. H. pulcherrimum, *Col.* (Pl. I. fig. 7.)

A tall, tufted, very handsome species, with a short, stout rhizome, which is covered with brown bristles. Stipes 3-6 in. long, wiry, erect, winged to the base. Fronds bright-green, 6-24 in. long, 4-6 in. broad, broadly ovate or oblong, often linear-oblong in long specimens, 3-4-pinnatifid; main rachis narrowly winged throughout, secondary flexuous; lower pinnæ 2-3 in. long, lanceolate with cuneate base; secondary pinnæ with several distinct pinnules on either side, which are divided into pinnatifid segments; ultimate segments linear, obtuse, entire. Sori numerous, free, axillary and terminal on the segments; involucres orbicular, divided to the base; valves entire.

This very fine fern is confined to New Zealand, where, however, it is much more local and restricted than *H. dilatatum.* A line drawn across the North Island from E. Cape to Kawhia marks about its northern limit; in the damp forests of the interior of the island it occurs rather commonly at 2,000 ft. elevation. In the South Island it is tolerably common down the W. Coast and throughout Otago, but is rare along the E. Coast, from the Kakarui Mountains northward to Marlborough. It is one of the handsomest ferns of the whole genus, and as it frequently occurs in a tufted form, it is readily transplanted. It grows tolerably freely in a case or damp greenhouse, requiring abundant moisture, good drainage, and free vegetable mould.

13. H. demissum, *Swartz.*

A matted species, with wide-spreading, glabrous and wiry rhizomes. Stipes 4-6 in. long, erect, firm, glabrous and shining, not winged. Fronds 4-12 in. long, 3-4 in. broad, deltoid or ovate-lanceolate, 3-4-pinnatifid, pinnate below; rachis slightly winged above; primary pinnæ triangular, cuneate below, divided nearly to the rachis into numerous pinnules, which are again divided into pinnatifid segments;

ultimate lobes very narrow, entire. Sori very numerous, terminal and axillary on the segments; involucres small, ovate; valves divided to the base, entire or denticulate.

Synonyms.—H. productum, *Kunze;* Trichomanes demissum, *Forst.*

A variety of this species with relatively long stipes and strongly-winged rachis has recently been described by Mr. W. Colenso as *H. erecto-alatum.* ("N.Z. Inst. Trans.," vol. xi. p. 431.)

Distribution.—Fiji, Java, several Polynesian islands, and the Philippines.

This dark-green, glossy fern grows most commonly on the ground, seldom on tree-trunks unless they happen to have plenty of earth on them. It is easily transplanted, and gives very little trouble to the cultivator, being a free grower and accommodating itself to circumstances more readily than any other species. It is abundant throughout New Zealand.

14. H. scabrum, *A. Rich.*

Rhizome stout, creeping, more or less covered with reddish hairs. Stipes 2-6 in. long, rigid, wiry, covered—as are the rachis and generally the midribs—with rough reddish hairs. Fronds 6-18 in. long (sometimes as much as 30 in. in very fine specimens), ovate-acuminate or deltoid, 3-pinnatifid, pinnate below; rachis winged above only; lower pinnæ lanceolate or oblong, acuminate, divided almost to the rachis into several pinnules, which are again pinnatifid; ultimate segments linear, obtuse, quite entire. Sori numerous, terminal on the lateral segments; involucres orbicular, divided nearly to the base; lips toothed.

Synonym.—Sphærocionium glanduliferum, *Presl.*

Distribution.—Confined to New Zealand. In the North Island it ranges from the N. Cape to Wellington, ascending to 2,000 ft., and is very common. In the South Island it extends from Cook Straits to Stewart Island, ascending to 3,000 ft.; and while rather rare down the E. Coast, and of local occurrence on the W. Coast, is again common on both sides of Foveaux Straits.

It is a very easily recognized species, its hairy stipes and rachis forming a most characteristic feature.

15. H. flabellatum, *Labill.*

A pale-green, glistening, often pendulous species, forming dense matted patches on the trunks of trees; rhizome long, creeping, wiry, covered with fine brown woolly hairs. Stipes 2-5 in. long, slender, rather rigid, woolly at the base, not winged. Frond 2-8 in. long, 2-3 in. broad, very variable, ranging from broadly ovate to linear, 3-pinnatifid, pinnate below; pinnæ close and imbricating, or distant, flabellate, broadly deltoid, divided almost to the rachis into several cuneate-based pinnules; ultimate segments linear, entire. Sori

numerous, small, terminal on the lateral segments; involucres orbicular or oblong, divided more than half-way down; lips entire.

Synonyms.—H. nitens, *Br.*; H. hookeri, *Bory.* and *V. den Bosch.*

Distribution.—Australia, the Philippines, and probably Sumatra; also Auckland and Chatham Islands.

A common fern in New Zealand, ranging from the Bay of Islands to Stewart Island; local along the E. Coast of the South Island. In the North Island it ascends to 2,500 ft.

Like *H. rarum*, this species sends its creeping rhizomes under the bark of decaying trees, or among the fibres of tree-fern stems, though not to the same extent, and is therefore not a very easy plant to lift. These two are both rather troublesome to cultivate.

16. H. rufescens, *Kirk.*

Rhizome creeping, slender. Stipes, costa and veins when young sparingly clothed with deciduous curved hairs. Stipes very slender, 1-2 in. long, exceeding the fronds. Fronds 1-1½ in. long, deltoid, sometimes cuneate at the base, pinnate; rachis winged above the second pair of pinnæ; pinnæ 2-pinnatifid, unequally rhomboid, the lowest pair divided nearly to the midrib; the basal pinnules spreading. Sori terminal; involucres small, half-immersed, divided nearly to the base, hairy when young; lips entire or minutely toothed.

This very recent addition to the genus is described in the "Transactions of the N.Z. Inst.," vol. xi. p. 457. It has been gathered in two localities only—viz., in the Ruahine mountains, in the N. Island, and at Okarita, Westland, in the S. Island.

17. H. ciliatum, *Swartz.*

Rhizome 1-2 in. long, filiform. Stipes 1-2 in. long, ciliated and decurrently winged above. Fronds 2-6 in. long, 1-2 in. broad, oblong, acuminate, 3-pinnatifid; main rachis broadly winged throughout and ciliated; lower pinnæ oblong or rhomboid, with a broad central undivided portion; segments linear, simple or forked, ciliated. Sori numerous, terminal on the lateral segments; involucres suborbicular, immersed; valves divided about half-way down; lips conspicuously ciliated.

Synonyms.—H. plumieri, *Hook.*; H. boryanum, *Willd.* Besides these, Baker, in the "Synopsis Filicum," includes no less than eleven species admitted by Van den Bosch.

Distribution.—Common in tropical America from Cuba to Brazil and Chili; E. Himalayas; W. tropical Africa, and in the E. in the Zambesi district, Mauritius, Madagascar, Bourbon, and other E. African Islands.

This fern was originally found (in New Zealand) near Nelson, by Mr. Travers, but the exact locality has been forgotten. It is said by Mr. Armstrong to occur—though rarely—in the Canterbury provincial district; I have not seen it.

18. H. subtilissimum, *Kunze.*

A rather small pendulous species, everywhere covered with tawny or brownish-red, silky, stellate hairs; rhizome filiform. Stipes 1-3 in. long, wiry, filiform, tomentose, not winged. Fronds 3-8 in. long, 1-2 in. broad, ovate-lanceolate or linear, 3-pinnatifid, pinnate below; main rachis slightly winged above; lower pinnæ divided nearly to the rachis into numerous alternate pinnules, which are again deeply divided into broad linear segments. Sori rather numerous, terminal on the lateral segments; involucres orbicular, divided nearly to the base; lips short, copiously ciliated.

Synonyms.—H. æruginosum, *Hook.*; H. berteroi, *Hook.*; H. franklinianum, *Col.* H. æruginosum, *Carm.*, is separated as a distinct species by Baker, but is considered to be identical by Sir J. D. Hooker. It is a Tristan d'Acunha species.

Distribution.—Chili, Chiloe, and Juan Fernandez.

In New Zealand this fern ranges from the Bay of Islands to Stewart Island, in which last place it is very common. It is also common in the damp forests of the interior of the North Island, at about 2,000 ft. elevation, and is abundant down the W. coast of the South Island, though rare along the whole E. Coast.

19. H. malingii, *Mettenius.*

A most curious little fern, covered everywhere with pale-brown, grey or reddish stellate tomentum; rhizome slender, filiform, creeping, with a few scattered hairs or scales. Stipes 1-3 in. long, slender, not winged. Fronds pendent or erect, rather rigid, 2-8 in. long, 1-1½ in. broad, linear-oblong, 2-3 or 4-pinnatifid; lower pinnæ oblong or rhomboid, divided to the rounded rachis into flabellate, deeply pinnatifid pinnules; ultimate segments linear, almost terete, obtuse and rather coriaceous. Sori terminal on the segments; involucres subglobose, divided about half-way down; valves toothed, densely pubescent.

Synonym.—Trichomanes malingii, *Hook.*

This remarkable plant is confined to New Zealand, but its nearest ally is H. sericeum, *Sw.*, a species occurring in tropical America. Its rarity probably adds to the interest which it excites in the minds of fern-collectors. The only localities in which it has been gathered are:—N. Island: Mt. Egmont. S. Island: Mountains between Blind Bay and Massacre Bay; Pine Hill and Mt. Cargill, near Dunedin; Banks' Peninsula, near Port Levy, and Pigeon Bay; and on the Franz-Joseph Glacier, W. Coast. Mr. Buchanan, in his sketch of the Botany of Otago, gives this fern as occurring rarely on both the East and West Coasts; the locality named above is the only one I am acquainted with in Otago. It appears to be a species easily cultivated.

GENUS VIII.—TRICHOMANES,* *Smith.* (Pl. I. fig. 8.)

Fronds filmy, usually pellucid, in texture like those of *Hymenophyllum*, and (except *T. reniforme*) formed of a single layer of cells, simple or pinnate or 2-3-pinnatifid; segments with one stout simple or branched midrib. Sori marginal, always terminating a vein, more or less sunk in the frond; involucre elongate, tubular or campanulate; the mouth truncated or winged, or slightly 2-lipped. Receptacle filiform, elongated, often considerably exserted beyond the mouth of the involucre, bearing the capsules chiefly at the base. Capsules sessile, depressed, surrounded by a complete, broad, nearly transverse ring, bursting vertically.

I.—Fronds small, pendulous, more or less pubescent with stellate hairs ... ... 1. T. lyallii.

II.—Fronds quite glabrous.

Fronds simple, reniform, erect ... ... 2. T. reniforme.

Fronds very delicate, 1-4 in. long, pinnatifid; rachis winged throughout. Midrib simple ... ... 3. T. humile.

Fronds very delicate, 2-5 in. long, pinnatifid, rachis only winged above. Midrib branched ... ... 4. T. venosum.

Fronds very delicate, 1-4 in. long, pinnate; rachis quite free ... ... 5. T. colensoi.

Fronds erect, 4-10 in. long, lanceolate, 3-4-pinnatifid, membranous, pale-green ... ... 6. T. strictum.

Fronds erect, 4-10 in. long, ovate or deltoid, 3-4-pinnatifid, subcoriaceous, dark-green ... ... 7. T. rigidum.

1. T. lyallii, *Hook.*

A small species pendulous from trees and rocks; rhizome capillary. Stipes 1-2 in. long, filiform. Fronds ½-2 in. long, suborbicular in outline, flabellately divided nearly to the base into narrow-linear segments, which are obtuse and entire or minutely toothed; midrib and margins covered with stellate pubescence. Sori 3 or 4, terminal on the segments; involucres obconic, sunk in the frond; lips ciliated, not dilated.

Synonym.—Hymenophyllum lyallii, *Hook. f.*

Distribution.—Confined to New Zealand. In the North Island it occurs in the district immediately to the north of Auckland, also on the Great Barrier Island at 2,000 ft. (which Mr. Kirk considers its northern limit), and is common at the Thames at 2,700 ft. In the

* Gr. *Thrix, trichos*, a hair; *manos*, soft; referring to the delicate texture of the fronds.

South Island it occurs in many localities on the W. Coast from near Hokitika to Foveaux Straits, and is reported by Mr. Armstrong as occurring sparingly in Canterbury provincial district.

This pretty little fern forms the connecting link between this and the preceding genus, and in the "Handbook to the N.Z. Flora" was included in *Hymenophyllum.*

2. T. reniforme, *Forst.* (*Kidney-fern.*)

Rhizome long, rigid, stout and creeping, with the fronds rather distant from one another. Stipes 4-8 in. long, naked, wiry. Fronds 2-4 in. in diam., orbicular-reniform, with a deep basal sinus, dark green, transparent when young, margins entire. Sori very numerous, crowded round the edges of the fronds; involucres tubular or urceolate; receptacle stout, much exserted and crowded with capsules.

Distribution.—Eastern Australia and the Chatham Islands. In New Zealand it is common in the North Island from Bay of Islands to Wellington, and ranging from sea-level to nearly 3,000 ft. Abundant in the South Island along the whole W. Coast as far as the Bluff, but quite absent in the eastern part of Otago, and very rare from the Waitaki northwards.

This is one of the most singular ferns known, and is an extremely beautiful plant. The profusion in which it grows in the damp bush of the Sounds of the W. Coast of Otago is remarkable; it covers square miles of ground, and gives quite a characteristic appearance to the undergrowth. It is not a difficult fern to cultivate if it gets a sufficiently humid atmosphere, abundance of water to its roots, and rapid drainage; and, with those requisites, will thrive in any soil that contains a fair share of vegetable mould, and is sufficiently light. Yet, probably, more failures are made with this, than with any other fern, by inexperienced cultivators.

3. T. humile, *Forst.*

Rhizomes capillary, creeping, densely intermatted. Stipes $\frac{1}{4}$-$\frac{1}{2}$ in. long, slender, winged above. Fronds pendulous, very pale, thinly membranous and nearly transparent, 1-4 in. long, $\frac{1}{2}$-1 in. broad, 2-pinnatifid, lanceolate or linear-oblong in outline; rachis narrowly winged; pinnæ pinnatifid, segments linear, simple or forked; costæ single in each segment, unbranched. Sori solitary, sunk in the short lateral segments; involucres urceolate, shortly 2-lipped, mouth spreading, receptacle more or less exserted.

Synonyms.—T. endlicherianum, *Presl.;* T. aureum, *V. den Bosch;* T. erectum, *Brack.*

Distribution.—Java and several of the Pacific Islands.

This is stated by Baker to be probably a mere variety of T. pyxidiferum *L.*, a species found throughout tropical America, South and West Africa, India, Borneo, and New Caledonia.

In New Zealand this pretty little fern is rather restricted in its distribution, though in the "N.Z. Handbook" it is said, on the authority of Banks and Solander, to be abundant throughout both islands. It is tolerably common throughout the whole of the North Island, ascending to 2,000 ft. But it is very sparingly distributed in the South Island, not occurring—as far as I am aware—to the south of Banks' Peninsula, where it is reported by Mr. Armstrong to be rare.

4. T. venosum, *Br.* (Pl. I. fig. 8.)

Rhizome capillary, wide-creeping, most frequently on the trunks of tree-ferns. Stipes 1-2 in. long, capillary, naked. Fronds pendulous, thinly membranous, shining, pellucid, 2-5 in. long, pinnatifid or pinnate below, linear; main rachis broadly winged above, free below; pinnæ linear or linear-oblong, simple or pinnatifid, cuneate at the base; costæ wavy, with alternate veins on each side. Sori solitary on each pinna, axillary on the upper margin; involucre immersed, tubular or urceolate; mouth dilated, shortly 2-lipped; receptacle capillary and exserted.

Distribution.—S.E. Australia and Tasmania; also Chatham Islands. With us this fern is widely distributed, occurring freely in both N. and S. Islands, and ranging into Stewart Island. It is probably common wherever there is any extent of moist forest-covered country.

A form of this has recently been described by Mr. Colenso under the name of *T. venustula.*

5. T. colensoi, *Hook. f.*

Rhizome capillary, hairy, wide-creeping. Stipes about 1 in. long, slender, naked. Fronds dark-green, very membranous, 1-4 in. long, linear-oblong, acuminate, 1- or 2-pinnate; pinnæ 5-10 pairs, distant, ovate or lanceolate-rhomboid, shortly stalked, pinnate below, pinnatifid above; segments narrow-linear acute; costæ single in each segment, not branched. Sori solitary, at the base of the segments, the tube of the involucre stalked, cylindric, mouth scarcely dilated; receptacle very slender, exserted.

This species is confined to New Zealand, and is by no means common. It was first found by Mr. Colenso at L. Waikare, and occurs sparingly in the southern portions of the N. Island. In the S. Island it has been recorded from Nelson, Okarita, Lake Wanaka, and Banks' Peninsula, and probably is to be found at other localities within the same areas.

6. T. strictum, *Menzies.*

A very tufted species, sending up numerous fronds from its short, stout rhizome. Stipes 3-4 in. long, stout, terete, very slightly winged above or quite naked, but with red-brown bristles at the base. Fronds erect, rather rigid, membranous, pale-green, 4-8 in.

long, lanceolate or linear-oblong, 3-4-pinnatifid or almost quite pinnate; main rachis very narrowly winged; pinnæ crowded, broadly lanceolate, ascending or recurved, 2-3-pinnatifid; ultimate segments narrow-linear. Sori few, at the base of the upper side of the pinnules; involucres funnel-shaped, erect, free, shortly stalked; receptacle more or less exserted.

Synonyms.—T. leptophyllum, *A. Cunn.*; T. cunninghamii, *V. den Bosch.*

Distribution.—Confined to New Zealand, and by no means a common species. In the North Island it occurs at a good many localities; *e.g.*, Hokianga, Auckland district, Pirongia, Tauranga, and the Thames, and ascends to about 2,700 ft. In the South Island it ranges from Nelson down the W. Coast to Dusky Bay, but is never generally distributed.

7. T. rigidum, *Swartz*; var. elongatum, *A. Cunn.*

A dark-green tufted species, with numerous rigid fronds ascending from a short, woody, horizontal rhizome. Stipes 2-8 in. long, stout, wiry, naked or very slightly winged above, sparingly hairy at the base. Fronds slightly coriaceous, very dark, 4-10 in. long, deltoid or ovate, acuminate, 3- or 4-pinnatifid or quite 2-pinnate, the main rachis being hardly winged; pinnæ crowded, imbricate, ovate or oblong-cuneate; pinnules deeply pinnatifid; ultimate segments broad, entire or toothed at the apices. Sori very numerous, axillary; involucres cylindric, mouth slightly dilated and 2-lipped; receptacle long, rigid, exserted.

Synonyms.—Very many names have been given to this species from other parts of the world, but as these have not been used in connection with the New Zealand form, it is quite unnecessary to detail them.

Distribution.—A very wide-ranging species, occurring throughout tropical America, S. Africa and many of its islands, Southern India and Ceylon, China, Japan, Malay Peninsula, and many of the Polynesian Islands.

It appears to prefer deep, dark woods, and is said in the "Handbook to the N.Z. Flora"—on the authority of Banks and Solander—to be abundant throughout both islands. It is common in the North Island, particularly in the northern portion of it, and ascends to 1,500 ft. In the South Island, however, it is rare, and does not occur, as far as I am aware, to the south of Banks' Peninsula.

Genus IX.—DAVALLIA,* *Smith.* (Pl. I. fig. 9.)

Rhizome wide-creeping, and more or less scaly. Frond compound, subcoriaceous in texture, veins always free. Sori oblong or globose, on or near the margin. Involucre coriaceous, terminal on the veins,

* In honour of a Swiss botanist, Edmd. Davall.

attached by a broad base, the apex always and the sides often free. Capsules stalked, with a dorsal striate ring.

Fronds 3-pinnate. Sori on the teeth of the segments ... ... 1. D. novæ-zælandiæ.

Fronds 4-pinnate. Sori minute, terminal ... ... 2. D. forsteri.

1. D. novæ-zælandiæ, *Colenso.* (Pl. I. fig. 9.)

Rhizome creeping, stout, covered with yellowish-brown filiform scales. Stipes 3-8 in. long, firm, erect, red-brown and glossy, quite glabrous or slightly hairy below. Fronds 6-18 in. long, 4-8 broad (sometimes 4 ft. long and 1½ ft. broad in very robust specimens), tri-pinnate, deltoid, ovate or oblong, acuminate, cut to the rachis—except towards the apex—into oblong-lanceolate segments, which are deeply pinnatifid ; ultimate segments linear, acute. Sori numerous on the teeth of the segments ; involucre orbicular, open at the apex and sides.

Synonym.—Acrophorus hispidus, *Moore.*

Distribution.—Confined to New Zealand, where it has a very wide range—from the Bay of Islands to Foveaux Straits. This is a very handsome fern, of a most elegant and delicate appearance, and it is one which grows readily under cultivation, requiring only a shady nook and a moderate supply of water. In the North Island, and particularly in the more humid parts, it attains very large proportions, and is a magnificent plant. Its nearest ally in the genus is *D. pulchra*, a North Indian species.

2. D. forsteri, *Carruthers.*

"Stipes 6-8 in. long, naked, stramineous. Fronds 6 in. long, rhomboid, 4-pinnate; pinnæ and pinnules ascending, rhomboid, stalked, the lowest the largest, cuneate-truncate on lower side at base; final segments ligulate-cuneate, 2-4 lines long, under ½ line broad, texture subcoriaceous, surfaces naked. Sori minute, terminal, with lamina produced on both sides as a border."

Synonym.—Adiantum clavatum, *Forst.*

This fern is probably more "wanted" by fern-collectors in New Zealand than any other. It was gathered by Forster at Dusky Sound, in the S.W. of Otago, about the year 1772, during Cook's second voyage to these islands, and from the specimens then preserved the above description was drawn up. It has apparently never been collected again. It belongs to a totally different section of the genus from *D. novæ-zælandiæ*, and is most nearly allied to *D. scoparia*, a species from New Caledonia.

GENUS X.—CYSTOPTERIS,* *Bernhardi.* (Pl. II. fig. 1.)

Rhizome short, creeping, or suberect under the surface. Fronds small, tufted, pinnate or 2-pinnate, thin in texture, veins free. Sori globose, small, inserted on the back of the veins, distant from the margin. Involucre membranaceous, suborbicular, attached by a broad base under the sorus, and at first covering it like a hood. Capsules pedicelled, with a dorsal striate ring.

1. C. fragilis, *Bernhardi.* (*Bladder-fern.*)

Stipes 2-4 in. long, slender, brittle, glabrous. Fronds 3-8 in. long, 1½-2 in. broad, oblong- or ovate-lanceolate, or 1- or 2-pinnate; main rachis slightly winged above; primary pinnæ rather remote, lanceolate- or ovate-deltoid; pinnules oblong-rhomboid, cut down to a broad central space into bluntly or sharply-toothed lobes.

Synonym.—C. novæ-zælandiæ, *J. B. Armstrong.*

Distribution.—Found in all parts of both N. and S. temperate zones and in mountains in the intermediate tropical zones. Occurs in Britain.

By no means a common fern in New Zealand, and very local in its occurrence. Except on the ranges near Mt. Egmont, I am not aware that it has been gathered in the North Island. In the South Island it occurs along the whole of the mountain ranges from Nelson to Foveaux Straits, and also on Banks' Peninsula, at elevations usually of 1,000-4,000 ft. It is quite a subalpine plant, and is to be sought for in dry open ground, and particularly among the clefts of rocks and stones. The typical European form is larger and more robust than ours, with usually more divided leaves, and a more persistent involucre.

GENUS XI.—LINDSAYA,† *Dryander.* (Pl. II. fig. 2.)

Rhizome creeping or tufted. Fronds usually compound, coriaceous; veins free. Sori linear along the margin or near and parallel with it. Involucre double, opening outwards, the inner valve membranous, the outer formed of the more or less changed margin of the frond.

Fronds pinnate, linear; pinnæ unilateral	1. L. linearis.
Fronds 2- or 3-pinnate; pinnæ equilateral.	
Fronds lanceolate, membranous; pinnæ alternate, veins usually simple	2. L. viridis.
Fronds broadly-ovate, coriaceous; pinnæ opposite, veins branched	3. L. trichomanoides.

* Gr. *Cystos*, a bladder, from the inflated involucre.
† In honour of Dr. Lindsay, a cryptogamic botanist of Jamaica.

1. L. linearis, *Swartz.* (Pl. II. fig. 2, *a* and *b*.)

Rhizome wiry, creeping, and scaly. Stipes 4-8 in. long, wiry, flexuous, black or purplish, shining. Fronds 6-18 in. long, very narrow, linear, simply pinnate, rather coriaceous, bright-green; pinnæ distant, ¼ in. long, more or less one-sided, cuneate or flabellate, toothed chiefly along the upper edge. Sori in a continuous line along the upper edge.

Distribution.—Australia, Tasmania and New Caledonia; also, eastward to the Chatham Islands.

In New Zealand the range of this fern is from North Cape to Stewart Island, but it is not an abundant fern everywhere, being rather local in its occurrence. It is to be found on stony and rocky ground, often in open, swampy country. In Canterbury and Otago it is rather rare, but reappears abundantly in a somewhat depauperated condition in Stewart Island, where it grows in cold, wet, and spongy peat mosses.

Though growing often in such unattractive-looking spots, and proving itself quite a hardy species in a state of nature, this fern is a most troublesome one to cultivate—and the remark apparently applies to all the species we have. When transplanted from its original habitat, the plant almost invariably fades away, and fails to put forth new fronds.

2. L. viridis, *Colenso.* (Pl. II. fig. 2.)

Rhizome short, with tufted fronds. Stipes 1-3 in. long, 3-gonous, shining, naked except at the base, where it is furnished with a tuft of linear brown scales. Fronds 6-12 in. long, lanceolate, acuminate, bright-green, membranous, 2- or 3-pinnate; main rachis flexuous; pinnæ alternate, ascending, 1-1½ in. long, obliquely- or rhomboid-lanceolate; pinnules simple, lobed or cut to the base into 2-4 linear cuneate segments; veins obscure, usually simple. Sori narrow.

Distribution.—Confined to New Zealand, where, however, it is both rare and very local. The following localities are given on the authority of Mr. T. Kirk, to whom our botanists are much indebted for the unravelling of the confusion which had arisen about this species:—*N. Island:* Port Fitzroy, Great Barrier Island, plentiful about waterfalls; Manukau, Te Whau, Mangarewa, Wanganui River. *S. Island:* Massacre Bay, Hokitika, West Coast of Otago. The habitat of this fern is always characteristic; it only occurs on rocks, in humid situations, and particularly where it can receive a continuous drip.

In the "Synopsis Filicum," L. microphylla, *Swartz*, is said to occur in New Zealand. It is, however, solely an Australian species. The misconception arose from *L. viridis* having been first placed as a variety or form of *L. trichomanoides* by Sir W. Hooker, but afterwards separated from it and united to *L. microphylla* by Mr. Baker, under which name it appears in both editions of the "Synopsis."

3. L. trichomanoides, *Dryander.*

Rhizome creeping, chaffy. Stipes 3-6 in. long, wiry, polished, 3-gonous, scaly at the base. Fronds 4-8 in. long, 2-3 in. broad, ovate-oblong or broadly ovate, rather coriaceous, 2- or 3-pinnate; pinnæ opposite, 2-3 in. long, lanceolate; pinnules cuneate, lobed on the upper edge; veins obscure, flabellate. Sori continuous on the margin.

Var. lessonnii (L. lessonnii, *Bory.*) Fronds simply pinnate, or 2-pinnate below; pinnæ linear, or oblong-lanceolate, usually lobed.

Distribution.—Tasmania, N. S. Wales, and Fiji.

In New Zealand this fern has as wide a distribution as the preceding species, but is not nearly so local. It is, however, much commoner in the N. Island, where it ranges from the Bay of Islands to Wellington, than in the South Island. It occurs in many localities along the West Coast, but is very local throughout Otago. Var. *lessonnii* is apparently confined to the North Island. This species is always confined to woods and shady places.

GENUS XII.—ADIANTUM,* *L.* (*Maidenhair.*) (Pl. II. fig. 3.)

Rhizome tufted or creeping. Fronds usually compound, 2-4-pinnate; pinnules on slender stalks; veins usually forked. Sori rounded or oblong, marginal, usually numerous and distinct; involucre formed of the reflexed, often reniform, coriaceous margins of the frond, opening inwards; surface veined.

I.—Fronds once or more pinnate.

* *Pinnules dimidiate; rachis naked, polished.*

Pinnules dark-green, membranous, sparsely hairy. Sori few, obreniform, in the sinuses of the crenate margins... ... ... 1. A. diaphanum.

Pinnules subcoriaceous, glabrous, glaucous. Sori numerous, roundish, in small hollows on the lobules or teeth of the margins ... ... 2. A. affine.

** *Pinnules dimidiate; rachis pubescent.*

Fronds 3- or 4-pinnate or decompound. Pinnules small, subcoriaceous. Sori small, rather elongate ... ... 3. A. formosum.

Fronds 2- or 3-pinnate. Pinnules large, herbaceous. Sori large, obreniform 4. A. fulvum.

*** *Pinnules flabellate, cuneate.*

Sori obreniform, in several roundish or transversely oblong patches ... 5. A. æthiopicum.

II.—Fronds not pinnately branched, but dichotomously forked.

Rachis and fronds more or less hispid 6. A. hispidulum.

* Gr. *Adiantos*, dry, from the leaves always throwing off water.

1. A. diaphanum, *Blume.*

Stipes 4-8 in. long, slender, erect, blackish, polished. Fronds 4-8 in. long, 1 in. broad, simply pinnate or with 1 to 3 branches at the base, which are sometimes nearly as large as the terminal one; pinnules shortly stalked, $\frac{1}{2}$-$\frac{3}{4}$ in. long, $\frac{1}{4}$-$\frac{1}{3}$ in. deep, the lower margin rather decurved, the upper one nearly parallel with it and crenate like the rounded outer margin, dark-green and membranous, with a few scattered hairs on the upper surface. Sori rather distant from each other, obreniform, placed in the sinuses of the upper and outer margin.

Synonyms.—A. affine, *Hook.* (not *Willd.*); A. setulosum, *J. Smith;* A. trapeziforme, *Forst.*

Distribution.—S.E. China, Java, New Caledonia, Aneitum, Fiji, Norfolk Island, N. S. Wales.

Not uncommon throughout New Zealand, but rather local in its occurrence. It is rather rare in the southern portion of the South Island. According to Mr. Kirk, it is chiefly to be found in alluvial situations.

It is an easily-cultivated plant, as, indeed, are most ferns of this beautiful genus. In transplanting, care must be taken not to injure the extremities of the slender rhizomes, as it is from these that new fronds spring up.

Considerable confusion has crept into the nomenclature of the New Zealand Maidenhairs, owing to the misappropriation of specific names. This is the second species described in the "Handbook Fl. N.Z.," under the name *A. affine*, whereas the following species here is the true *A. affine* of Willdenow, but is described in the "Handbook" as 5, *A. cunninghamii.*

2. A. affine, *Willd.*

Rhizome creeping, scaly. Stipes 6-10 in. long, erect, polished, black and glossy. Fronds sparingly and irregularly branched, terminal central pinna 4-6 in. long, lateral small, erecto-patent, lowest again branched; pinnules few, $\frac{1}{2}$-$\frac{3}{4}$ in. long, $\frac{1}{4}$ in. broad, subcoriaceous, glossy and glaucous, dimidiate, lower edge straight, upper nearly parallel with it, crenate, as is the round or oblique outer margin. Sori numerous, rather small, placed in small hollows round the upper and outer margins; involucres obreniform or suborbicular.

Synonyms.—A cunninghamii, *Hook.;* A. formosum, *A. Rich.*, not *R. Br.*, which is the next species.

Distribution.—Confined to New Zealand and Chatham Islands.

The range of this species is very wide—from N. Cape to Otago; it seems to prefer localities near the sea, and is common in lowland districts of both islands.

It is the easiest of the genus to cultivate, and is a very hardy fern.

3. A. formosum, *Br.*

Stipes 12-18 in. long, stout, erect, scabrid, blackish. Fronds 18-24 in. long, 12-18 in. broad, deltoid, 3- or 4-pinnate, primary branches remote; rachis flexuous, pubescent above, shining and glabrous below; pinnules $\frac{1}{4}$-$\frac{1}{2}$ in. long, subcoriaceous, glabrous, oblong, rounded or oblique, cuneate at the base, more or less lobed, the lower ones stalked. Sori numerous, rather small, placed on the lobes or teeth of the pinnules; involucres rather elongate, narrow, between obreniform and transversely oblong.

Distribution.—Temperate Australia.

In New Zealand this species is confined to the North Island, where it seems to be very local. It occurs in the Kaipara and Wangarei districts in the far north, and also between the Wairarapa and Manawatu rivers.

4. A. fulvum, *Raoul.*

Stipes 6-9 in. long, strong, erect, polished, blackish-brown, scabrous below, with rough hairs. Fronds 9-18 in. long, 6-8 in. broad, olive-green, ovate-deltoid; rachis scabrous and rather hairy, glossy; terminal pinna 4-6 in. long, about $1\frac{1}{2}$ in. broad; lateral pinnæ erecto-patent, lower branched again; pinnules rather coriaceous, $\frac{3}{4}$ in. long, $\frac{1}{4}$ in. broad, dimidiate, lower margin nearly straight, upper almost parallel, and with sharply-toothed lobes, like the oblique outer margin. Sori large, numerous, placed in small depressions round the upper and outer margins; involucres obreniform.

Distribution.—New South Wales, Norfolk Island, and Fiji.

Occurring in woods in both islands at low-lying elevations. It is most common in the northern part of the North Island, but extends to the middle of the South Island, where it becomes local. I am not aware of its having been found to the south of Banks' Peninsula.

5. A. æthiopicum, *L.* (Pl. II. fig. 3.)

Rhizome tufted. Stipes 4-9 in. long, very slender, erect, blackish-brown, glabrous and polished, as is the very slender flexuous rachis. Fronds 9-18 in. long, 4-9 in. broad, usually deltoid in outline, 3- or 4-pinnate; lower pinnules deltoid; most of them suborbicular, $\frac{1}{4}$-$\frac{1}{3}$ in. broad, base cuneate, rounded or nearly straight, upper margin with broad, shallow lobes, flaccid and thinly-membranous in texture, pale-green. Sori 2-6, rather large, in the hollows of the upper margin; involucres obreniform or transversely oblong.

Synonyms.—A. assimile, *Swartz;* A. trigonum, *Labill.;* A. emarginatum, *Bory.;* A. thalictroides, *Willd.;* A. crenatum, *Poir.*

Distribution.—Throughout many tropical regions:—In Africa, from the Cameroons on the W., and Abyssinia on the E., to the Cape colony; also in Bourbon and Madagascar; Southern Islands; in America, from Texas and California to Chili and Monte Video; temperate and tropical Australia; Tasmania.

Similar in distribution to the last species, occurring commonly in the North Island, but becoming rare as we come south. It is found as far south as Banks' Peninsula, but is very rare in that locality. It is not found in any part of Otago.

A favourite species with fern-cultivators, as it shows to great advantage as a pot-plant, and is easily grown.

6. A. hispidulum, *Swartz.*

Stipes 6-15 in. long, stout, erect, dark-brown, polished, scabrous. Fronds dichotomous, with the main divisions branched flabellately, often 2-partite; rachis and surfaces of the pinnules hispid; pinnæ 6-9 in. long, $\frac{1}{2}$-1 in. broad; pinnules subcoriaceous, olive-green, dimidiate, $\frac{1}{3}$-$\frac{3}{4}$ long, $\frac{1}{6}$-$\frac{1}{3}$ in. broad, subrhomboidal, rather broader on the side next the stem, outer and upper margins rounded or oblique, and finely toothed. Sori numerous, almost contiguous in the notches of the upper and outer margins; involucres suborbicular.

Synonyms.—A. pedatum, *Forst.* (not Linnæus); A. pubescens, *Schkuhr.*

Distribution.—Widespread in the tropical regions of the old world, occurring in Africa on the banks of the R. Niger, and on the Zambesi, also in Bourbon and Mauritius; again in Southern India and Ceylon, several of the Pacific Islands, and in N. S. Wales; also in the Chatham Islands.

Common in the North Island of New Zealand, from N. Cape to Cook Straits. It is said by Mr. Armstrong to occur in Banks' Peninsula and the Midland district of Canterbury, but no other collector appears to have found it in these localities.

Genus XIII.—HYPOLEPIS,* *Bernhardi.* (Pl. II. fig. 4.)

Rhizome wide-creeping. Fronds ample, 2- to 4-pinnate, often with glandular hairs. Sori small, subglobose, marginal, uniform, distinct, placed usually in the sinuses of the ultimate segments of the frond; involucre spurious, formed of the reflexed margin, the teeth of which are curved inwards over the sori.

Rhizome scaly. Fronds 2-5 ft. high, 3- or 4-pinnate, slightly hairy and glandular	1. H. tenuifolia.
Rhizome scaly and woolly. Fronds 6-18 in. high, 2-pinnate, glabrous ...	2. H. distans.
Rhizome naked. Fronds 6-18 in. high, 3- or 4-pinnate, slightly hairy below, ultimate segments sharply toothed	2. H. millefolium.

* Gr., *Hypo*, under; *lepis*, a scale, from the spurious membranous involucres.

1. H. tenuifolia, *Bernhardi.*

Rhizome stout, scaly. Stipes 1-2 ft. high, stout, erect, brown, scabrid, naked, or pubescent. Fronds herbaceous, 2-5 ft. long, 1-2 ft. deltoid, 3- or 4-pinnate; rachis tomentose; lower pinnæ 12-18 in. long, 6-9 in. broad, ovate-acuminate; pinnules lanceolate; secondary pinnules 1-1½ in. long, lanceolate, pinnatifid; segments linear-oblong, obtuse, toothed; sori 2-6 on the ultimate segments, placed at the sinuses of the teeth.

Synonyms.—H. dicksonioides, *Hook.*; H. pallida, *Hook.*; Cheilanthes ambigua, *A. Rich*; C. arborescens, *Swartz*; C. pellucida, *Colenso*; Lonchitis tenuifolia, *Forst.*

Distribution.—Australia, Tasmania, Java, Norfolk Island, and many of the Polynesian Islands. Also in the Chatham Islands. Ranging widely in New Zealand from N. Cape to Foveaux Straits, and on the whole a very common fern. In Otago it is rather local. This fern is chiefly to be found at the edge of the bush, and springs up readily in bush clearings. It is very closely allied to *Polypodium rugulosum*, and some forms are quite undistinguishable from that fern. *Hypolepis* only differs from *Polypodium* (which has naked sori) in having the spurious involucre covering its sori, which are placed—not on the veins—but in the sinuses of the margins of the frond.

2. H. distans, *Hook.* (Pl. II. fig. 4*a*.)

Rhizome woolly, and covered with scaly brown hairs. Stipes 6-12 in. long, slender, flexuous, chestnut-brown, slightly rough. Fronds 6-12 in. long, 4-5 in. broad, ovate-lanceolate, 2-pinnate; pinnæ opposite, distant, spreading at right angles with the rachis, lanceolate, 2-3 in. long, ½ in. broad; rachis scabrous; pinnules ¼ in. long, varying from oblong to deltoid, obtuse, pinnatifid, glabrous and herbaceous. Sori very small, 2-4 to a pinnule, placed in the lower sinuses.

Distribution.—Confined to the Chatham Islands and New Zealand, where, however, it is found throughout all open country at low elevations. It is to be looked for at the edges of the bush and in sheltered localities; but, like the others of the genus, requires plenty of air and light, and is not found in the forest districts. Though wide-spread, it is very local in its occurrence, passing frequently into *Polypodium rugulosum*, and not to be distinguished in some of its forms from that species.

3. H. millefolium, *Hook.* (Pl. II. fig. 4.)

Rhizome stout, naked, except at the junction of the stipes, where there are a few scaly hairs. Stipes 4-6 in. long, erect, pale-coloured, naked, or with a few hairs or scabrous points. Fronds 6-18 in. long, 4-8 in. broad, broadly ovate or deltoid, 3-pinnate; lower pinnæ erecto-patent, 4-6 in. long, 1-2 in. broad, ovate or lanceolate;

pinnules $\frac{3}{4}$ in. long, ovate; secondary pinnules deeply cut in several small sharply-toothed lobes; costæ and under surface of the frond slightly hairy. Sori small, roundish, on the lobes of the pinnules, usually solitary on the lobes.

Distribution.—Confined to New Zealand, where it is wide-spread, frequenting open and hilly ground, often up to considerable elevations. In the North Island it is local, having been gathered on the Ruahine Mountains and at Wangarei in the far north.

In the South Island it is common along the whole eastern side of the main ranges, but is very local on the west.

This is a hardy fern, and thrives very readily under cultivation. Its fronds—like those of several species of *Pteris*, &c.—are cut down every winter, and come up fresh and green in the spring.

GENUS XIV.—CHEILANTHES,* *Swartz.* (Pl. II. fig. 5.)

Rhizome stout, short and scaly. Fronds rather small, seldom exceeding 1 ft. in height, tufted, rigid, erect, 2- or 3-pinnatifid, veins all free. Sori at first small, subglobose, terminal or nearly so on the veins, afterwards more or less confluent. Involucres formed from the reflexed margin of the fronds, not quite continuous.

Fronds deltoid; pinnules $\frac{1}{2}$-1 in. long, ascending	1. C. tenuifolia.
Fronds oblong-lanceolate; pinnules $\frac{1}{6}$-$\frac{1}{3}$ in. long	2. C. sieberi.

1. C. tenuifolia, *Swartz.*

Rhizome covered with silky scales. Stipes tufted, 4-8 in. long, erect, wiry, flexuous, purplish-black, polished, slightly hairy below. Fronds 4-8 in. long, 3-4 in. broad, deltoid, 3-pinnatifid; rachis narrowly winged above, or naked, polished; pinnæ in 6-12 nearly opposite or alternate pairs, ascending at an acute angle with the rachis, the lowest 2-4 in. long, 1-2 in. broad, deltoid; pinnules deltoid or oblong, cut down to the rachis into deltoid or oblong, entire or irregularly lobed segments. Sori often continuous, covering the back of the pinnule and projecting beyond its margin; involucres more or less toothed.

Distribution.—Throughout India, S.E. China, Malay Peninsula and Archipelago, Polynesia, Australia, Tasmania and Uruguay (S. America).

Rare in New Zealand, having been collected only in the Hawke's Bay district in the North Island; and at Lyttelton Harbour, Banks' Peninsula, Lake Hawea and mountains about Queenstown in the South Island.

* Gr. *Cheilos*, a lip; *anthos*, a flower, from the fructification on the margins of the frond.

2. C. sieberi, *Kunze.*

Stipes densely tufted, 2-6 in. long, erect, wiry, polished, dark-brown, slightly hairy at the base. Fronds 3-9 in. long, $\frac{3}{4}$-$1\frac{1}{2}$ in. broad, narrow oblong-lanceolate, acuminate, 3-pinnatifid; rachis wiry, naked, polished; pinnæ in 3-15 opposite pairs, lower pairs distant, $\frac{3}{4}$-$1\frac{1}{2}$ in. long, $\frac{3}{8}$-$\frac{1}{2}$ in. broad, broadly deltoid; pinnules oblong-deltoid, pinnate at the base; segments entire, lobed or crenate. Sori rarely continuous, and never projecting beyond the margin of the pinnule; involucres small, roundish, not apparently toothed.

Synonym.—C. preissiana, *Kunze.*

Distribution.—Australia, New Caledonia, Isle of Pines.

Tolerably common in New Zealand, usually growing in rocky and stony ground, and very frequently close to the sea. In the North Island it is quite characteristic of the volcanic districts about Auckland, where it grows plentifully on the dry scoria rocks; it extends to the N. Cape, but is rare at the Thames.

In the South Island it is also tolerably common throughout Otago and Canterbury.

In the "Handbook of the N.Z. Flora," this and the preceding species are mixed together under the name *C. tenuifolia*, var. *sieberi.* Both species thrive well and easily under cultivation, preferring a bright airy spot to grow in and stony well-drained soil, but—as Mr. Potts remarks—they have usually a very shabby and scrubby appearance from the extreme persistence of the withered fronds. In the fernery these can easily be cut—not torn—away, when the plants present a very trim, neat appearance.

Genus XV.—PELLÆA,* *Link.* (Pl. II. fig. 6.)

Fronds pinnate (in the N. Z. species), tufted, coriaceous, dark-green; veins forked, free, very obscure. Sori continuous round the edge of the pinnules; involucre more or less membranous, very narrow, quite continuous, formed of the more or less changed margin of the frond.

Pinnæ lanceolate, more or less falcate, acute ... ... 1. P. falcata.

Pinnæ oblong or rounded, obtuse or mucronate ... ... 2. P. rotundifolia.

1. P. falcata, *Fée.*

Rhizome scaly, wide-creeping, short, wiry. Stipes 3-6 in. long, strong, erect, nearly black, more or less hispid. Fronds 6 in.-3 ft. long, 1-2 in. broad, narrow-linear; rachis densely scaly and tomentose; pinnæ 10 to 20 on each side, $\frac{1}{2}$-$1\frac{1}{3}$ in. long, $\frac{1}{4}$-$\frac{1}{2}$ in. broad,

* Gr. *Pellos*, dark coloured, from the colour of the fronds.

linear- or oblong-lanceolate, more or less falcate, acute or mucronate, broadly obliquely cuneate or cordate at the base, coriaceous and glabrous. Sori in broad marginal lines, soon hiding the narrow involucre.

Synonym.—Platyloma falcata, *J. Sm.*

Distribution.—India, Malay Peninsula, Australia, Tasmania, and Kermadec Islands.

Rather a rare fern in New Zealand, occurring in the North Island in various spots from the Thames to the Bay of Islands, and in the South Island only recorded from Dun Mountain near Nelson. According to Mr. Potts, to whom we are indebted for the last locality, this plant is particularly easy of cultivation, and is most readily propagated from the wide-creeping rhizome.

2. P. rotundifolia, *Hook.* (Pl. II. fig. 6.)

Rhizome shortly creeping, stout, scaly. Stipes 6-12 in. long, stout, erect, hispid and more or less covered with linear, chaffy scales. Fronds tufted, 6-12 in. long, 1-1½ in. broad, narrow-linear; rachis scaly and tomentose; pinnæ in 10-20 pairs, oblong or rounded, obtuse or mucronate, rounded or obliquely truncate at the base, coriaceous, glabrous. Sori in a broad marginal—often interrupted—line, soon hiding the involucre.

Synonym.—Platyloma rotundifolia, *J. Sm.*

Distribution.—Norfolk and Chatham Islands.

Very generally distributed throughout both islands, from N. Cape to Foveaux Straits, though rare in the moist forest regions of the West Coast. Though rather fond of shade, this fern seems to prefer dry rocky soil; it is a very free grower under cultivation, and readily repays any attention it receives in its increased luxuriance. Intermediates occur frequently between this and the preceding species, and though the typical forms are distinct and easily separated, these intermediates are often very puzzling.

Genus XVI.—PTERIS,* *L.* (Pl. II. fig. 7.)

Rhizome usually creeping. Fronds very various, mostly tall and very compound; veins forked, free or netted. Sori linear, continuous along the margin of the frond; involucres slender, filiform, usually membranous, at first covering the sorus, at length more spreading.

I.—*Veins forked, free.*

Fronds more or less tufted, tall, 2- or 3-pinnate; lower pinnæ usually very compound; membranous and glabrous	1. P. tremula.

* Gr. *Pteron*, a wing, from its pinnæ; the typical name now for all ferns.

Rhizome subterranean. Fronds solitary, tall, 3-4-pinnate, rigid; pinnules linear, decurrent; glabrous or pubescent ... ... 2. P. aquilina.

Rhizome usually above-ground, hairy. Fronds 1-2 ft. high, rigid, more or less scabrous; ultimate segments minute ... ... 3. P. scaberula.

II.—*Veins netted.*

Fronds 2-4-pinnate, membranous; pinnules stalked, deltoid, deeply lobed; lobes coarsely-toothed ... ... 4. P. macilenta

Fronds 2- or 3-pinnate, membranous; pinnules sessile and decurrent, shortly lobed; lobes toothed at the apex ... ... 5. P. comans.

Fronds pinnate or 2- or 3-pinnate, subcoriaceous, glaucous below; pinnules broad, adnate or decurrent on the rachis; margins usually entire 6. P. incisa.

1. P. tremula, *Br.*

Stipes more or less tufted, 1-2 ft. long, strong, erect, polished. Fronds 2-4 ft. long, membranous, deltoid in outline; rachis smooth; lower pinnæ 1 ft. or more long, and often bipinnate; upper pinnæ pinnate, segments linear-oblong, obtuse, fertile usually entire; apices of frond and pinnæ pinnatifid, with numerous obliquely-decurrent lobes; veins sunk. Sori copious, sometimes filling up the whole segment, except the costa.

Synonyms.—P. affinis, *A. rich.*; P. tenuis, *A. cunn.*

Distribution.—Australia, Tasmania, and Norfolk Island. Closely allied to *P. chilensis*, a species occurring in Peru, Chili, and Juan Fernandez.

A common fern throughout the North Island, where it ascends to 3,000 ft. Rare in the South Island, and not found south of Banks' Peninsula.

In cultivation this fern thrives best in sheltered, somewhat shady spots, requiring a considerable depth of rich light soil, containing a large proportion of vegetable mould. It is rather delicate in the southern parts of the South Island.

2. P. aquilina, *L. var.* esculenta *(Brake or Bracken).*

Rhizome thick and creeping, subterranean. Stipes 1 ft. long or more, strong, erect, pale, shining, glabrous. Fronds from 1 or 2 ft. high, up to 10 ft., deltoid in outline, usually 3-pinnate, coriaceous; primary pinnæ distant, lowest pair largest and most compound;

uppermost pinnæ simple; pinnules numerous, lanceolate, deeply pinnatifid or pinnate, ending in a linear, entire, obtuse segment, lateral segments linear, suddenly decurrent on the rachis, which, together with the surface, is either glabrous or pubescent. Sori continuous.

Synonym.—P. esculenta, *Forst.*

Distribution.—The local variety of this fern is confined to, but is everywhere distributed over, the south temperate zone; the typical form of the species being found over all other parts of the world.

In New Zealand it is the commonest fern to be found, occurring in all parts, including the outlying groups of islands, and ranging from sea-level to 4,000 ft. or more. It still covers thousands of acres of land in both islands, but attains its greatest dimensions in the North Island, where the roasted and pounded rhizomes are still eaten by the Maoris, under the name of *Roi*, when better fare is not forthcoming. In the Andes this same species has been seen 14 ft. in height.

Though so common that probably few would be inclined to introduce this fern into cultivation, it is worthy of remark that it is a most difficult species to re-establish if once it has been lifted from the soil; in this respect resembling species of *Lindsaya* and *Schizæa*.

3. P. scaberula, *A. Rich.*

Rhizome wide-creeping, often above ground, stout and more or less hairy and scaly. Stipes 6-12 in. long, strong, reddish-yellow, scabrous. Fronds 12-18 in. high, lanceolate or ovate-lanceolate, yellowish-green, coriaceous, 2- or 3-pinnate; lower pinnæ 4-9 in. long, lanceolate, pinnules cut into very numerous oblong-toothed segments $\frac{1}{6}$-$\frac{1}{4}$ in. long; rachis often flexuous, scabrous. Sori usually covering the whole segment.

Distribution.—Confined to New Zealand and Chatham Islands.

This is a very common and hardy species. According to the "Handbook of the N.Z. Flora" it is stated on the authority of Banks and Solander to occur generally in woods, but it will most frequently be found in exposed, and frequently very dry situations. It ranges from N. Cape to Stewart Island.

It is the most easily cultivated of our New Zealand species of *Pteris*, and when once well established in a suitable spot, is apt to become too rampant. It is not too particular about soil—some of the best specimens I have ever gathered having been obtained on a dry clay bank, quite destitute of mould.

4. P. macilenta, *A. Cunn.* (Pl. II. fig. 7.)

Stipes 6-18 in. long, rather slender, smooth, shining, pale-coloured, as are the rachis and costæ. Fronds pale-green, membranous and flaccid, 1-5 ft. high, broadly deltoid, 2-4-pinnate; terminal pinna cut nearly to the rachis into numerous oblong-toothed lobes; lowest

pinnæ 1 ft. long or more, very compound; pinnules stalked, deltoid, cut into ovate-oblong segments, which are deeply coarsely toothed, especially towards the tips, veins netted only slightly. Sori in the notches, not reaching the point of the segments.

Distribution.—Rather common throughout the North Island of New Zealand. The only localities in the South Island in which it has been obtained are in the Grey Valley, W. Coast, where it was gathered—about 3 miles above Greymouth—by Prof. J. von Haast, and on Banks' Peninsula.

It grows readily in cultivation, but in the South Island—at least in the southern part—it requires protection. It is one of the most beautiful and delicate species of the genus.

5. P. comans, *Forst.*

Stipes 1 ft. or more long, glabrous, polished, as are the rachis and costæ. Fronds bright-green, membranous and flaccid, 1-5 ft. high, deltoid, 2-pinnate, terminal pinna very long, cut nearly to the base into linear-oblong, toothed or lobed segments, which are decurrent at the base; lateral pinnæ ovate-lanceolate, lowest 1 ft. or more long, often compound at the base; pinnules sessile, rarely stalked, usually adnate and decurrent, $\frac{3}{4}$-$1\frac{1}{2}$ in. long, linear or linear-oblong, more or less lobed, serrate at the tips; veins netted throughout. Sori falling short of the apex of the segments.

Synonyms.—P. Endlicheriana, *Agardh;* P. micropteris, *Mett.;* Litobrochia comans, *Presl.*

Distribution.—Tasmania, Australia, Norfolk Island, Polynesian Islands and Juan Fernandez.

In New Zealand this is confined to the northern end of the North Island, from the Bay of Islands to the Thames.

6. P. incisa, *Thunberg.* (Pl. II. fig. 7*a.*)

Rhizome stout, creeping, glabrous. Stipes stout, erect, glabrous, polished, straw-coloured. Fronds 2-5 ft. high, quite glabrous, glaucous below, membranous or subcoriaceous, broadly deltoid, 2- or 3-pinnate; upper pinnæ simply pinnate, lower with numerous pinnatifid pinnules; lowest often very compound; ultimate segments $\frac{1}{3}$-$\frac{2}{3}$ in. long, broadly oblong or lanceolate, obtuse or acute, entire or crenate, adnate and decurrent on the rachis; venation very variable, sometimes quite free or more or less netted. Sori continuous to the extremity of the segments, or interrupted.

Synonyms.—P. Brunoniana, *Endl.;* P. montana, *Colenso;* P. vespertilionis, *Lab.;* Litobrochia vespertilionis, *Presl.*

Distribution.—A fern of extremely variable form, and very widely distributed, ranging in America from the W. Indies and Central America to Chili, and westwards to Juan Fernandez; also in Western tropical and Southern Africa, India, Ceylon, Formosa,

several Polynesian Islands, Australia, Tasmania, and the Chatham and Auckland Islands.

In New Zealand it is an extremely common species, and ranges from the N. Cape to Stewart Island, frequenting chiefly the edge of bush land and springing up abundantly in bush clearings. Mr. Kirk reports it from the Great Barrier Island as attaining a height of 7 feet in favourable localities; while it has attracted the attention of all observant visitors to the Hot Springs district, by the luxuriant growth it makes among the hot pools and steam jets of that region.

Though a common species, its delicacy and beauty render this a favourite fern. It is difficult to transplant as its rhizome grows to a considerable length, but when once established in a good vegetable mould, it grows freely.

GENUS XVII.—**LOMARIA**,* *Willdenow.* (Pl. II. fig. 8, and frontispiece.)

Rhizome creeping or ascending into a short trunk. Fronds pinnate or pinnatifid, rarely simple or 2-pinnatifid, of two forms, the outer broader and barren or fertile at the base only, the inner narrower and fertile; veins free, simple or forked. Sori linear, continuous, parallel with the midrib and occupying the whole or nearly the whole of the space between it and the edge. Involucre membranous, formed of the revolute edge of the frond, sometimes very obscure.

I.—*Sterile fronds pinnatifid or simple, rarely pinnate below; segments with a broad base.*

Rhizome short, creeping. Fronds large, dark-green, coriaceous, pendulous, simple or with few lobes	1. L. patersoni.
Stem ascending into a short trunk. Fronds linear, coriaceous, brown below; segments oblong or rounded	2. L. discolor.
Rhizome stout. Fronds deltoid, coriaceous; segments falcate, lower deflexed	3. L. vulcanica.
Rhizome short, stout, erect. Fronds linear or lanceolate, membranous; segments oblong, slightly falcate ...	4. L. lanceolata.
Rhizome short, erect. Fronds lanceolate, rigidly coriaceous; segments more or less lanceolate and falcate...	5. L. dura.
Rhizome slender, creeping. Fronds linear, coriaceous, fertile the longest; segments linear-oblong, obtuse ...	6. L. alpina.

* Gr. *Loma*, a border or fringe, so named from the linear involucre.

Rhizome short, woody. Fronds linear, subcoriaceous, fertile the shortest; segments oblong, obtuse ... ... 7. L. banksii.

Rhizome slender, creeping. Fronds short, lanceolate, membranous; segments linear-oblong, crenate ... ... 8. L. pumila.

II.—*Sterile fronds pinnate; pinnæ with narrow bases.*

Rhizome stout, woody, erect. Fronds 1-6 ft. long, coriaceous; pinnæ linear ... ... 9. L. procera.

Rhizome climbing. Fronds pendulous ... 10. L. filiformis.

Rhizome very short. Fronds very dark green, membranous, linear-oblong, with a large terminal pinna ... ... 11. L. nigra.

Rhizome stout, erect. Fronds linear, membranous; pinnæ oblong or rounded; stipes and rachis scaly ... 12. L. fluviatilis.

Rhizome short. Fronds linear-oblong, membranous; pinnæ linear-oblong; stipes and rachis glabrous ... ... 13. L. membranacea.

III.—*Fronds 2-pinnatifid.*

Rhizome long, suberect. Fronds ovate-acuminate ... ... 14. L. frazeri.

1. L. patersoni, *Sprengel.*

Rhizome short, creeping. Stipes 2-6 in. long, stout, naked or winged, rather scaly below. Sterile fronds 1-3 ft. long, dark-green, shining, very coriaceous, pendulous; quite entire, linear-oblong, with an acuminate apex, or pinnatifid with from 6 to 9 segments on each side; segments 2-6 in. long, 1-2 in. broad, linear-lanceolate, decurrent at the base, acuminate at the apex; fertile fronds as long as sterile, but segments only about $\frac{1}{8}$ in. broad; sori occupying the whole space between the midrib and margin.

Synonyms.—L. elongata, *Blume.*; L. colensoi, *Hook. f.*; L. heterophylla, *Colenso*; L. cumingiana, *Hook.*; L. punctata, *Blume.*

Distribution.—India, Ceylon and the Philippines eastwards and southwards to Fiji; S.E. Australia and Tasmania.

In the North Island this species occurs throughout the hilly forest-clad regions as far north as the Thames, usually at elevations of 1,000-2,000 ft. In the South Island it is common down the W. Coast, but is local in its distribution along the E. Being a shade-haunting and moisture-loving species, it is only found wherever there is any extent of bush land.

In cultivation this fern succeeds well if it be provided with a habitat sufficiently like that which it is always found in, in the native state. It must have shade and moisture in abundance, and grows best in a constant drip.

2. L. discolor, *Willd.*

Rhizome thick, ascending into a short trunk, 1-3 ft. high, from the summit of which the crown of fronds is given off. Stipes 3-6 in. long, strong, glossy, clothed below with long, linear-subulate scales. Fronds 1-3 ft. long, pale-green above, red-brown below, very coriaceous; sterile 3-6 in. broad, narrowing gradually at both extremities; segments numerous, spreading, contiguous, linear, 1½-3 in. long, cut almost to the rachis, margin wavy; fertile fronds with very narrow segments (sometimes the lower half is sterile and leafy).

Synonyms.—Onoclea nuda, *Labill.;* Stegania nuda and S. falcata, *R. Br.;* Osmunda discolor, *Forst.*

Distribution.—Australia, Tasmania, Norfolk Island, and in the Chatham, Auckland and Campbell Islands.

A very abundant species in New Zealand, ranging from N. Cape to Stewart Island, and occurring chiefly in the more open tracts of bush land, where there is not too much undergrowth and moisture.

It is a very hardy species, and will grow in almost any soil; under good treatment it attains immense proportions, bearing a tuft of fronds 6 ft. or more in diameter.

L. attenuata, *Willd.*,

is usually described as a New Zealand fern; but as it only grows in the Kermadec Islands, it can hardly be termed so, strictly. It is a very wide-ranging species in other parts of the world. It may be distinguished from *L. discolor* by its creeping rhizome, its usually shorter alternate fronds, which are not red-brown below, and its linear-lanceolate pinnules, which are broad at the base and narrow to an acuminate apex.

3. L. vulcanica, *Blume.*

Rhizome very stout, woody, erect or sub-prostrate; stipes 4-8 in. long, pale, erect, with numerous blackish subulate scales at the base. Fronds ovate-lanceolate or deltoid, 6-18 in. long, almost pinnate below; barren bright-green and coriaceous; segments spreading, lanceolate, 2-4 in. long, slightly dilated at the base, margin thickened and more or less crenate, lowest pair deflexed; fertile very narrow, suddenly dilated at the base, distant.

Synonyms. — L. pilosa, *Brack.;* L. deflexa and L. deltoidea, *Colenso.*

Distribution.—Tasmania, Polynesian Islands and Java.

This is rather local in its occurrence in New Zealand, though ranging from Foveaux Straits to Auckland. It has been recorded from nearly every region of both islands, but can only be called an

abundant species in a few parts. Mr. Potts states that it is very common on Banks' Peninsula and the Malvern Hills.

It is a hardy species, and thrives very well under cultivation.

4. L. lanceolata, *Sprengel.*

Rhizome stout, often ascending into a trunk, 1-2 ft. high. Stipes 3-6 in. long, firm, erect, dark-brown, with blackish subulate scales at the base. Fronds tufted, erect, 6-18 in. long, pale-green, rather membranous; sterile 2-4 in. broad, lanceolate, very gradually narrowing below; segments numerous, close-set, 1-1½ in. long, oblong-lanceolate, slightly falcate, entire, sinuous or crenate, veins prominent; fertile segments linear, spreading or falcate, acuminate.

Synonyms.—L. blechnoides, *Bory.*; Stegania lanceolata, *R. Br.*

Distribution.—Tasmania, Australia, several of the Polynesian Islands and var. *blechnoides*, from Chili; also in the Auckland, Campbell and Chatham Islands.

This is one of the most abundant ferns in New Zealand, and ranges from N. Cape to Stewart Island. It is also very hardy, and is one of the most easily cultivated of all our ferns.

L. acuminata, *Baker,*

is a species intermediate between *L. lanceolata* and *L. attenuata*, but is only known from Kermadec and Norfolk Islands, and has therefore no need to be described here.

5. L. dura, *Moore.*

Rhizome erect. Stipes 1-2 in. long, thick, erect, with ovate-lanceolate scales at the base. Fronds tufted, 1 ft. or more long, lanceolate, cut down to the rachis below, thick and leathery; sterile dwarfed below into rounded lobes; middle segments oblong, sub-falcate, upper ones narrower and more acuminate; fertile with crowded segments which are broad and very blunt, decurrent at the base above, ultimately becoming involute. Sori very densely crowded; involucre transversely wrinkled, the margin fringed.

Synonym.—L. rigida, *J. Smith.*

Distribution.—Originally described from the Chatham Islands, but since found to occur in many localities round the E., S. and S.W. coasts of the South Island, and also in the Auckland Islands. It has been gathered at Banks' Peninsula, Catlin River, Bluff Hill and at some of the Sounds in the S.W. of Otago. It is only found close to the sea, frequently in situations where it is exposed to the spray.

6. L. alpina, *Sprengel.*

Rhizome slender, wide-creeping, clothed with reddish, lanceolate, chaffy scales. Stipes 4-8 in. long, slender, brown, sparingly scaly. Fronds coriaceous, 3-18 in. long, ½-¾ in. broad, linear; sterile with numerous linear-oblong, obtuse segments about ⅓-½ in. long; fertile

longer, with narrower, more distant segments, which are usually linear, obtuse, and either spreading or curved upwards.

Synonyms.—L. linearis, *Col.;* Stegania alpina, *R. Br.;* Polypodium Penna-marina, *Poiret.*

Distribution.—Temperate S. America, Tasmania, Alps of S.E. Australia; also in the Chatham Islands.

This is a very common fern in both islands of New Zealand, chiefly in mountainous regions, though it frequently descends to the sea-level. In Otago it is abundant up to 3,000 ft.

It is a very hardy and vigorous species, thriving most luxuriantly under cultivation, and when once established needs little attention beyond that requisite to keep it within due limits.

7. L. banksii, *Hook. f.* (Pl. II. fig. 8.)

Rhizome short, stout, woody, ascending at the summit, covered with matted fibres and above with reddish lanceolate scales. Stipes 2-4 in. long, erect, dark-coloured, scaly below. Fronds tufted, numerous, coriaceous, quite glabrous; sterile 6-18 in. long, about 1 in. broad, very narrowly lanceolate; segments numerous, close-set, broadly oblong or semi-orbicular, rounded, entire, very broad at the base, lower often forming a wing to the stem; fertile shorter and more slender, segments narrower and more distant.

Confined to New Zealand, where, though ranging from the North Cape to Stewart Island, it is rather local in its occurrence. In the Auckland district it is extremely rare and local; it has been recorded from North Cape, Kawau, Little Barrier Island, &c. Further south it becomes more common, but is nowhere abundant. It occurs in many localities on the East and West Coasts of Otago district.

It grows readily in cultivation, but requires a shady spot and abundant supply of moisture.

8. L. pumila, *Raoul.*

Rhizome slender, creeping, clothed with blunt, chaffy, reddish scales at the apex; roots wiry. Stipes 1-4 in. long, slender, chaffy at the base. Fronds tufted, membranous, 3-5 in long, lanceolate; sterile about ½ in. broad; segments spreading, ovate or ovate-oblong, ¼-⅓ in. long, obtuse, crenate; fertile fronds with longer stipes; segments linear-oblong, obtuse, rather distant and more or less decurrent at the base.

This fern was gathered by M. Raoul during one of the visits of the French frigate *L'Aube* to Akaroa, either in 1840-41 or in 1842-43, and since then has apparently never been found again.

9. L. procera, *Sprengel.*

Rhizome rather short, stout, woody, clothed with large reddish scales. Stipes 6-12 in. long, stout, erect, scaly below. Fronds very

variable in form and structure, usually 1-4 ft. long, but in very favourable situations reaching as much as 8 or 10 ft., very coriaceous, rachis naked or scaly; barren fronds with 3-20 pairs pinnæ, 3-12 in. long, which are linear or lanceolate, rounded, cordate or auricled at the base, minutely toothed; fertile pinnæ narrow linear, distant, 4-6 in. long; involucre broad, membranous and ciliated.

Synonyms.—L. latifolia, *Colenso;* L. gilliesii, *Hook.;* L. capensis, *Willd.;* Stegania procera and minor, *Br.;* Blechnum procerum, *Labill.;* Parablechnum procerum, *Presl.;* Osmunda procera, *Forst.;* Osmunda capensis, *L.*

Distribution.—Throughout Central and South America to Chili; South Africa; Malay and Polynesian Islands; Australia and Tasmania; also in the Kermadec, Chatham, Auckland and Campbell Islands.

A most abundant fern in New Zealand, ranging throughout all the islands, and ascending from sea-level to 3,000 ft. and even more. Some of the smaller forms are common in swamps and marshes, and very similar states in rather open, dry woods. The largest and most robust forms are usually on the banks of streams, where the fronds are frequently pendulous. Sir J. D. Hooker defines four varieties in the "Flora of New Zealand," which keep their characters under cultivation.

It is an extremely hardy plant under cultivation; and though it will grow readily in somewhat dry spots, it thrives best with plenty of water and good under-drainage.

In vol. ix. p. 491 of the "Trans. N.Z. Institute," Mr. T. H. Potts has described a peculiar and constant variety of this species under the name of *L. duplicata*, from its branched fronds.

10. L. filiformis, *A. Cunn.*

Rhizome climbing trees, stout, covered with chaffy scales. Stipes 1-4 in. long, rigid, often chaffy below. Fronds pendulous, glabrous, coriaceous, of three forms; sterile linear- or ovate-lanceolate, 1-2 ft. long; pinnæ 2-3 in. long, ½ in. broad, stalked, linear-lanceolate, tapering to a long point, regularly crenate-dentate; those of the lower part of the caudex usually 3-4 in. long, 1 in. broad, linear; pinnæ oblong, obtuse, sharply-toothed; fertile ovate; pinnæ 3-4 in. long, numerous, narrow linear.

Synonyms.—L. propinqua, *A. Cunn.;* L. pimpinellæfolia, *Hook. f.;* Osmunda reptans, *Banks and Sol.;* Stenochlæna heteromorpha, *J. Sm.*

Distribution.—Fiji.

In the "Handbook Fl. N.Z.," this very distinct species is stated, on the authority of Banks and Solander, to be "abundant throughout the North and Middle Islands." It is common in the North Island and the northern portions of the South Island, but does not extend as far south as Banks' Peninsula. It is quite unknown in Otago.

11. L. nigra, *Colenso.*

Rhizome very short, stout, clothed with linear scales at the base. Stipes 2-4 in. long, slender, erect, densely scaly, as is the rachis. Fronds tufted, very dark green, membranous, glabrous, rarely pubescent below, 8-12 in. long; sterile linear-oblong or lyrate, usually pinnatifid above, with a large blunt terminal lobe, cut down below to the rachis into rather unequal, oblong, obtuse, sinuate-dentate pinnæ; fertile with few distant linear pinnæ, terminal one long.

Synonym.—Polybotrya nana, *Fée.*

Confined to New Zealand, where it occurs in dark, gloomy woods. In the North Island it occurs at elevations ranging from 1,000 to 3,000 ft., and, though not abundant, is universally spread from Whangarei to Wellington. In the South Island it occurs very sparingly at Banks' Peninsula, and in one or two parts of Eastern Canterbury, according to Mr. Armstrong, but is much more common on the West Coast, where it grows usually near sea-level.

In cultivation this fern requires conditions as similar as possible to those of its native habitat, and as these are not readily obtainable in most open-air ferneries, I would recommend it to be always grown in a shady, moist locality within a greenhouse or Wardian case.

12. L. fluviatilis, *Sprengel.* (*See frontispiece.*)

Rhizome stout, clothed above with brown, linear scales. Stipes 3-4 in. long, erect, scaly, as is the rachis. Fronds tufted, linear, membranous, 8-20 in. long; sterile 1-2 in. broad, with numerous oblong, rounded, spreading pinnæ, which are waved or crenate, and confluent at the apex of the frond; fertile very narrow, with narrow-linear, suberect, obtuse pinnæ, which are $\frac{1}{3}$-$\frac{2}{3}$ in. long.

Synonyms.—L. rotundifolia, *Raoul;* Stegania fluviatilis, *Br.*

Distribution.—S.E. Australia and Tasmania.

A most abundant fern throughout New Zealand, which attains its greatest luxuriance, as its name implies, when growing on the banks of streams. It is not confined to such habitats, however, but grows both in the open and in the bush, at elevations ranging from sea-level to 2,000 ft.

It is an extremely hardy species, and thrives very readily under cultivation.

13. L. membranacea, *Colenso.*

Rhizome short, stout, with dark-brown linear scales above. Stipes very short, naked, as is the rachis. Fronds tufted, 6-10 in. long, membranous; sterile 1-1$\frac{1}{2}$ in. broad; pinnæ spreading, oblong or linear-oblong, obtuse, crenate, $\frac{1}{2}$-$\frac{3}{4}$ in. long, $\frac{1}{4}$ in. broad, lowest suborbicular, quite distinct, uppermost confluent; fertile longer than sterile, on a longer stipes; pinnæ rather distant, linear, erecto-patent.

This species is allied to *L. fluviatilis*, and is intermediate in habit between it and *L. lanceolata*. It is exclusively confined to New Zealand, and has a wide range in both islands, though it is not an abundant species. It is tolerably common from the Thames northwards to the Bay of Islands, also in various other parts of the North Island. In the South Island it occurs very locally, being found in many spots from Nelson to Otago. It is rare down the whole West Coast.

14. L. frazeri, *A. Cunn.*

Rhizome slender, erect, often lengthened into a trunk 2-3 ft. high, clothed at the top with linear, dark-brown scales. Stipes 4-6 in. long, strong, erect, scaly at the base, glabrous above and more or less interruptedly winged with triangular lobes, as is the rachis. Fronds numerous, tufted, glabrous, membranous, 10-18 in. long, 4-6 in. broad, ovate-acuminate, 2-pinnatifid; pinnæ linear-lanceolate, the lower ones 2-3 in. long, $\frac{1}{2}$-$\frac{3}{4}$ in. broad, cut down very nearly to the rachis into linear-oblong mucronate slightly-toothed pinnules, which have decurrent bases. Fertile fronds similar to or narrower than the sterile.

This is a very remarkable species, differing in habit from all the others of the genus, and is only found in New Zealand. It is particularly characteristic of the northern portion of the North Island, being common from the N. Cape to the Thames, but becoming rare further south. In the South Island, it was gathered by Lyall during the cruise of the *Acheron*, about the year 1848, at Massacre Bay, in the Nelson district; but I am not aware of any other habitat, nor does it seem to have been gathered there since. According to Mr. Potts, this fern is very much eaten down by cattle, whenever they meet with it.

Genus XVIII.—DOODIA,* *R. Brown.* (Pl. II. fig. 9.)

Rhizome short. Fronds tufted, pinnate or pinnatifid; veins forming one or two series of arches between the midrib and edge, on which the sori are placed. Sori oblong or slightly curved, in one or more rows parallel with the midrib; involucre of the same shape as the sorus, membranous, opening inwards.

1. D. media, *R. Br.*

Stipes 4-6 in. long, black, with subulate scales at its base, sometimes scabrous, usually smooth above, as is the rachis. Fronds tufted, 6-12 in. (rarely 2 ft.) long, lanceolate; pinnæ numerous, spreading, linear, acute or obtuse, toothed or sharply serrate, the lower more or less rounded or auricled, those in the upper part of the frond more or less connected at the base, the apex of the frond

* In honour of Saml. Doody, an English cryptogamic botanist.

frequently elongated and entire. Sori oblong, usually in a single row on each side of the midrib, sometimes quite confluent.

Var. 1. *media* (proper).—Fronds erect, pinnate only in the lower half or two-thirds, coriaceous; pinnæ 1-2 in. long.

Var. 2. *connexa* (D. connexa, *Kunze*).—Fronds 1-2 ft. high, rather membranous, pinnate in the lower half or two-thirds; pinnæ 3-6 in. long.

Var. 3. *caudata* (D. caudata, *R. Br.*).—Fronds more or less prostrate or decurved, rather flaccid, pinnate nearly to the apex; pinnæ ½-1 in. long. Fertile fronds longer, narrower and usually more upright than the sterile.

Considerable difference of opinion prevails among botanists as to the value of the characters which separate the above forms. In the "Synopsis Filicum," the first and third are treated as distinct, but closely allied species, with the second as a variety of *D. media*. In Bentham's "Flora Australiensis," *D. caudata* is described, and its variety *media*; while in the "Handbook to the N.Z. Flora," all three are treated as distinct species.

Synonyms.—D. kunthiana, *Gaudichaud*; D. rupestris, *Kaulfuss*; Woodwardia caudata, *Cav.*; Woodwardia media, *Fée*; &c.

Distribution. — Australia, Tasmania, and many of the Pacific Islands.

In New Zealand this species is confined to the North Island, the typical variety being common throughout the northern portion from N. Cape to Poverty Bay; it is, however, found throughout the island. It is a hardy fern, growing often with great vigour on poor, dry soil, and is to be chiefly found on open, hilly ground. Var. *connexa* is much more local in its occurrence, but is to be met with from Tauranga northwards, and on several of the islands in Hauraki Gulf. Var. *caudata* is tolerably common throughout the island; a somewhat fragrant form of it, with more or less falcate pinnæ, occurs in the Wellington and Wairarapa districts.

All the varieties are easily grown, but in the southern portions of the colony require some protection. They can bear the sun and drought very well, when thoroughly established, and therefore only require to be guarded against severe frost.

GENUS XIX.—ASPLENIUM,* *L.* (Pl. III. figs. 1 and 2, and frontispiece.)

Rhizome usually short and thick. Fronds tufted, pinnate, or 2- to 4-pinnate. Sori linear or rarely oblong, on veins proceeding obliquely from the midrib, usually distant from the margin. Involucres membranous, similar in form to the sori, attached along one side to the vein, and opening along the other towards the midrib.

* Gr. *a*, privative, *splen*, the spleen; reputed to have medicinal action on the spleen, and hence called Spleenworts.

A very large and most variable genus, of which some of the New Zealand species are very constant and definite in form, while others are extremely inconstant and pass into one another, thus rendering their classification a work of considerable difficulty. Sir J. D. Hooker, in the "Handbook Fl. N.Z.," characterizes *twelve* species, but states that many of them pass so readily into one another that only *five* universally separable forms occur in the islands.

All our species are very hardy, and grow most readily under cultivation.

Sori linear, diverging from the midrib. Fronds pinnate or rarely pinnate below.

Pinnæ $\frac{1}{4}$-$\frac{1}{2}$ in. long, nearly as broad as long.

Fronds weak, diffuse, rooting at the tips; pinnæ obliquely obovate or fan-shaped, veins flabellate ... ... 1. A. flabellifolium.

Fronds small, tufted; pinnæ oblong or or obovate, veins few, forked, diverging from a midrib ... ... 2. A. trichomanes.

Pinnæ numerous, 1-6 in. long, linear or linear-oblong, acute or acuminate.

Fronds usually very thick; pinnæ oblong or lanceolate, veins often inconspicuous ... ... 3. A. obtusatum.

Fronds coriaceous; pinnæ lanceolate, acuminate; veins close, very oblique; sori very numerous, parallel, giving a striate appearance to the under-surface ... ... 4. A. falcatum.

Sori linear, diverging from the midrib, and close to the margin of the segments. Fronds 2- or 3-pinnate, segments usually narrow.

Fronds 3-10 in. long, 2-pinnate, membranous; pinnules stalked, $\frac{1}{6}$-$\frac{1}{4}$ in. long; sori few, large ... ... 5. A. hookerianum.

Fronds 1-3 ft. long, flaccid, often proliferous; pinnules lanceolate, acuminate ... ... 6. A. bulbiferum.

Fronds 3-6 in. long, stout, coriaceous, ovate, acuminate; pinnules ovate or obovate, obtuse ... ... 7. A. richardi.

Fronds 1-3 ft. long, coriaceous, narrow; pinnules very narrow, linear ... ... 8. A. flaccidum.

Sori more or less curved and cylindrical. Fronds 2- or 3-pinnate.

Fronds 2-3 ft. long, membranous, deltoid 9. A. umbrosum.

1. A. flabellifolium, *Cavanilles.* (Pl. III. fig. 1.)

Rhizome very small. Stipes 3-6 in. long, slender, flexuous, green or brown. Fronds tufted, procumbent, straggling widely and rooting at the tips, 6-18 in. long; pinnæ 10-15 on each side, sessile, flabellate, $\frac{1}{4}$-$\frac{1}{2}$ in. long and broad, broadly lobed and the lobes sharply toothed. Sori 3-8 on each pinna, oblique, irregular.

Synonym.—A. flabelliforme, *Hook.*

Distribution.—Australia and Tasmania.

A very common fern in New Zealand, always growing in rocky or stony ground. It occurs throughout both islands, though rather local in forest-clad districts. It is the most easily cultivated species of the whole genus, as well as one of the most beautiful, and succeeds as well under pot or basket culture as in the open air.

2. A. trichomanes, *L.*

Rhizome short, thick. Stipes 1-4 in. long, naked, chestnut-brown, polished. Fronds tufted, 3-12 in. long, erect, linear, rather coriaceous; pinnæ very numerous in opposite pairs, $\frac{1}{6}$-$\frac{3}{8}$ in. long, oblong or obovate, slightly crenate, obliquely cuneate at the base. Sori 3-6 on each side of the midrib, linear-oblong, oblique.

Distribution.—Throughout the north temperate zone, "from Britain and the Azores eastward to Japan and the Himalayas, where it ascends to 6-8,000 ft.," Northern Polynesia, N. America, and the Andes of S. America, S. Africa, Australia, and Tasmania.

In New Zealand this little fern is found in the open mountainous country of both islands; like the preceding species, it grows chiefly among rocks and stones. In the N. Island it occurs in the ranges from E. Cape to Taranaki and south to Wellington, but apparently has not been found to the north of Tauranga. In the S. Island it occurs throughout the whole of the central ranges, also in the Kaikouras and in Banks' Peninsula, at elevations of 500-3,000 ft.

An extremely hardy species, which grows readily under cultivation, if its natural conditions of life are imitated as much as possible.

3. A. obtusatum, *Forst.*

Rhizome short, thick, scaly. Stipes 3-6 in. long, very stout, greyish, clothed at the base with large, thin, grey, lanceolate scales. Fronds 6-18 in. long, unusually thick and coriaceous, very variable, linear-oblong to deltoid; pinnæ 2-12 pairs, shortly stalked, varying from $\frac{3}{4}$-$1\frac{1}{2}$ in. long, and obliquely oblong or ovate-lanceolate, obtuse to 3-6 in. long, and lanceolate, acuminate, crenate, serrate or pinnatifid, bases truncate, cuneate or rounded.

This species is taken by me to include a number of forms, which, though quite distinct in their typical states, are so united by gradual and intermediate transitional stages as to be most difficult of separation. They pass also, by almost imperceptible gradations, from the

simply pinnate form into two or three other species with bi- or tri-pinnate fronds. The following varieties represent the most prevalent forms :—

Var. 1. *obliquum.*—Fronds 1-2 ft. long, linear or linear-oblong; pinnæ 1-4 in. long, $\frac{3}{4}$-1 in. broad, lanceolate, narrowing to an acuminate apex, margins crenate or serrate; sori $\frac{1}{2}$ to $\frac{3}{4}$ in. long, close together.

Synonyms.—A. obliquum, *Forst.*; A. apicidentatum, *Hombr. and Jacq.*

A common littoral form, growing on rocks and banks close to the sea-shore. Common from N. Cape to Stewart Island.

Var. 2. *scleropium.*—Fronds long, very thick and coriaceous; pinnæ 1-4 in. long, $\frac{1}{2}$-$\frac{3}{4}$ in. broad, narrow lanceolate, apex very elongate, margins regularly and closely toothed to $\frac{1}{6}$ in. or more; sori extending to the segments.

This is a transition form tending towards *A. flaccidum*, and in its typical state is found "in woods near the sea" in the Auckland Islands only.

Var. 3. *lucidum.*—Fronds large, often 2 ft. long or more, and 1 ft. or more broad at the base, rather flaccidly coriaceous; pinnæ oblong-lanceolate, lowest often 6 in. long, 1-1$\frac{1}{2}$ in. broad, very acuminate, margins deeply toothed, particularly on the upper side, rachis often dark-coloured; sori very long, numerous and linear.

Common from N. Cape to Stewart Island; also in the Chatham Islands.

Var. *paucifolium* of the "Handbook Fl. N.Z." is only a dwarf form, with few pinnæ on the frond.

Var. 4. *lyallii.*—Fronds 8-18 in. long, 4-9 in. broad at base, rather membranous in texture; pinnæ lanceolate-deltoid, the lower ones cut to the rachis into deeply-toothed pinnules, which are cuneate at the base and distinctly stalked, while those above are deeply pinnatifid.

This is a transition form between *A. obtusatum* and *A. bulbiferum*; it is tolerably common throughout the islands, and also occurs in the Chatham Islands.

A. obtusatum in all its forms is a littoral fern, and is seldom found at any great distance from the sea.

In one or other of its varieties it is found in Peru and Chili, several of the Polynesian Islands, and in Australia.

4. A. falcatum, *Lamarck.*

Rhizome creeping, often on trees, clothed with large brown scales. Stipes 6-9 in. long, firm, erect, greyish or brown, nearly naked. Fronds tufted, coriaceous, 6-24 in. long, erect, lanceolate or linear-lanceolate; pinnæ rather numerous, nearly horizontal, 2-6 in. long, $\frac{1}{2}$-1 in. broad, lanceolate, acuminate, sharply lobed or pinnatifid, and toothed, lower side of the base obliquely truncate, upper broad and

auricled; veins close, very oblique. Sori very long, reaching nearly to the margin, close.

Synonym.—A. polyodon, *Forst.*

Distribution.—An abundant fern in S. Africa, India, Ceylon, Malacca, Polynesian Islands and Australia; also in the Chatham Islands. Tolerably common throughout New Zealand, but seldom at any great distance from the coast. It ranges from N. Cape to Stewart Island, and in some parts ascends to 2,000 ft.

A. caudatum, *Forst.*,

a somewhat similar fern to the last, and probably only a variety of it, is included in the New Zealand Flora, in the "Handbook Fl. N.Z.;" but as it only occurs in the Kermadec Islands, on the extreme outskirts of the region, it hardly merits more than mention here. Its range in the Old World is similar to that of *A. falcatum*, but it is also found in S. America.

5. A. hookerianum, *Colenso.*

Rhizome short, fibrous. Stipes 1-4 in. long, slender, greenish, with narrow deciduous scales, which are also on the rachis. Fronds tufted, 2-12 in. long, 2-4 in. broad, membranous, ovate or oblong, 2-pinnate, with several long-stalked pinnæ on each side, which are 1-2 in. long; pinnules also stalked, about ¼ in. long, cuneate at the base, rounded and crenate or lobed above, veins subflabellate. Sori 3-5 on a pinnule, on the disk.

Var. *colensoi* (A. colensoi, *Hook. f.*).—Pinnules deeply cut into linear segments, each with a single vein, and a solitary oblong sorus on the margin.

Synonym.—A. adiantiodes, *Raoul.*

Distribution.—S.E. Australia. Tolerably common in both islands of New Zealand. In the North Island it occurs chiefly at about 1,500 ft. elevation, and ranges from Whangarei to Wellington—occurring, however, very locally in many parts. In the South Island it is commoner, and occurs in all the more open localities. It is a fern occurring chiefly in rocky ground, and is very hardy under cultivation. Var. *colensoi* has about the same distribution, but is not so common as the typical form. Intermediates between the two occur, while the species passes into the allied *A. richardi*, and by it into some forms of *A. flaccidum.*

6. A. bulbiferum, *Forst.* (*See frontispiece.*)

Rhizome stout, horizontal or oblique, scaly above. Stipes 6-12 in. long, greenish, firm, erect, scaly at the base, and with deciduous scales above and on the rachis. Fronds 1-3 ft. long, bright-green, erect or pendulous, herbaceous, and more or less flaccid; pinnæ numerous, horizontal, often proliferous from the upper surface, sometimes 6-8 in. long, cut down to the winged rachis into numerous lanceolate-ovate pinnules, which are again cut into slightly-toothed

linear-oblong segments. Sori on the disk of the more entire segments, often filling its whole breadth when mature, almost on the margin of the more cut ones.

Var. *laxum* (A. laxum, *R. Br.*).—Fronds more slender, usually pendulous and more compound; segments narrow, with the sori almost marginal.

Var. *tripinnatum*.—Fronds 3-pinnate, sori marginal;—a transitional form between *A. bulbiferum* and *A. flaccidum*.

Var. *shuttleworthianum* (A. shuttleworthianum, *Kunze*).—Fronds large, 4-pinnatifid below. Another transitional form, sometimes referred to *A. flaccidum*.

Synonyms.—A. tremulum, and A. fabianum, *Hombr. and Jacq.*; Cænopteris appendiculata, *Labill.*

Distribution. — Australia, Tasmania, New Caledonia, Samoa, Penang, N. India, S.E. Africa and several of its islands, Central America; also found in the Chatham Islands.

Common throughout all parts of New Zealand, chiefly occurring in damp woods. It is one of the most variable and also one of the most beautiful species of the genus, and is very easily cultivated. It passes into nearly all the other species of the section.

7. A. richardi, *Hook. f.*

Rhizome short, stout, with subulate scales at its apex. Stipes 3-6 in. long, stout, greenish, scaly. Fronds tufted, 5-6 in. long, ovate, acuminate; pinnæ 1-1½ in. long, close-set, lanceolate, erecto-patent, cut down to a winged rachis into numerous crowded ovate or obovate pinnules, which are again deeply pinnatifid into linear obtuse or mucronate segments; veins solitary in each segment. Sori solitary, oblong, close to the margin of each segment.

Synonyms.—A. adiantioides, *var.* richardi, *Hook. f.*; A. raoulii, *var.* richardi, *Mettenius*.

Distribution.—Confined to New Zealand, and occurring locally in various parts of the S. Island, and more sparingly in the N. Island. It was originally collected near the mouth of the New River, at the extreme south end of the S. Island, but has been gathered at various points in both the east and west of the Otago district; also along the lower heights of the Southern Alps, on the Malvern Hills, Banks' Peninsula and in the Wellington district.

This fern is probably not entitled to specific rank, being apparently an intermediate form between *A. hookerianum* and *A. flaccidum*, with both of which it is connected by almost imperceptible gradations.

8. A. flaccidum, *Forst.* (Pl. III. fig. 2.)

Rhizome stout, erect, with large, subulate, membranous scales above. Stipes 4-8 in. long, stout, greenish, naked above, scaly only

at the base. Fronds tufted, usually pendulous, coriaceous, 6 in.-3 ft. long, pinnate or 2-pinnate, very variable; pinnæ 4-10 in. long in larger forms, lanceolate, rigid and erect, or flaccid and drooping, stalked, deeply pinnatifid or cut down to the rachis into narrow linear, oblique or incurved, obtuse pinnules, which are $\frac{1}{3}$-$\frac{2}{3}$ in. long, and bear one vein in each. Sori oblong, on or near the margin of the segments.

Synonyms.—A. heterophyllum, *A. Rich.;* A. odontites, *R. Br.;* Cænopteris flaccida, *Thunberg;* C. novæ-zælandiæ, *Sprengel;* Darea flaccida, *Smith.*

Distribution. — Australia, Tasmania, Natal and the Sandwich Islands; also found on the Auckland and Chatham Islands.

This is an extremely variable species, passing into *A. richardi*, *A. bulbiferum*, *A. hookerianum*, *A. obtusatum*, and even in some of its forms into *A. falcatum*. In the "Handbook to the N.Z. Fl.," six varieties are defined, but these are just some of the intermediate forms referred to. Its habitats are very various, the typical flaccid forms being found chiefly in damp, forest regions, pendulous from trees or rocks; the sea-side forms show a tendency to pass into the varieties of *A. obtusatum*, while those occurring in alpine districts are usually short, stout, and very coriaceous.

In almost all its varieties it is a very hardy and easily cultivated fern. It is common in all parts of New Zealand.

9. A. umbrosum, *J. Smith.*

Rhizome stout, creeping. Stipes 1 ft. or more long, strong, erect, with dark scales below, polished above. Fronds 2-4 ft. long, broadly deltoid, 1-1½ ft. broad, bright-green, membranous and rather flaccid, 2- or 3-pinnate; pinnæ ovate lanceolate, acute or acuminate; pinnules 1-2 in. long, oblong-lanceolate, cut down to the rachis into numerous linear-oblong, obtuse, sometimes unequal segments, which are usually deeply incised or crenate; veins oblique, usually forked. Sori close, several on each segment, oblong; involucre large, membranous, tumid, bursting usually along the margin, the sori often at length covering the centre of the segment.

Synonyms.—A. Australe, *Brackenridge;* A. brownii, *Hook.;* A. physosorus, *Sieb.;* Allantodia australis and A. tenera, *R. Br.*

Distribution.—Madeira, Canaries, Azores, Guinea Coast, Himalayas (ascending to 6-8,000 ft.), Ceylon, Java, Australia and Tasmania.

In New Zealand this is the most limited in distribution of all the *Asplenia*, occurring chiefly to the north of Auckland in the N. Island, and only at Nelson in the S. Island.

It is a beautiful species, but in the greater gart of these islands is too delicate for any but in-door culture. It grows in its native habitats in damp, deeply-shaded woods.

GENUS XX.—ASPIDIUM,* *Swartz.* (Pl. III. fig. 3.)

Rhizome slender or stout and creeping, or forming a short, thick, erect or inclined trunk. Fronds 2- or 3-pinnate. Sori globose, dorsal or terminal on the veinlets. Involucre orbicular, covering the sorus when young, flat or convex, fixed by the centre.

(All the New Zealand species belong to the sub-genus *Polystichum*, characterized by their rather coriaceous texture, their usually awned teeth, and free venation.)

Rhizome erect or ascending.

Fronds 1-3 ft. long, narrow stipes and rachis, with large brown scales mixed with hairs. Involucre orbicular, flat 1. A. aculeatum.

Fronds 8-24 in. long, ovate, rigid. Stipes and rachis with narrow black scales. Involucre with small dark disk ... 2. A. richardi.

Fronds 10-20 in. long, ovate-oblong, rigid. Stipes with large, brown, white-edged scales. Involucre with large black disk ... ... 3. A. oculatum.

Fronds 4-10 in. long, rather flaccid. Stipes and rachis with large, pale, membranous scales. Involucre large, much inflated and sub-globose ... ... 4. A. cystostegia.

Rhizome creeping.

Fronds 1-3 ft. long, subdeltoid, very coriaceous. Stipes with few deciduous scales. Involucre large ... ... 5. A. capense.

1. A. aculeatum, *Swartz; var.* vestitum, *Hook.*

Rhizome stout, woody, erect or ascending, sometimes rising to a short trunk 2-4 ft. high. Stipes 6-12 in. long, clothed with large, brown, pale-margined, membranous scales, which are ovate-lanceolate, acuminate or lacerate, and ½-1 in. long; these are continued to a greater or less degree up the rachis, and mixed with brown, woolly, hairs. Fronds tufted, 1-3 ft. long, linear or ovate-lanceolate, and narrowed below; pinnæ very numerous, close, nearly horizontal, 2-6 in. long, ½-¾ in. broad, linear-lanceolate; pinnules numerous, ovate-rhomboidal, pungent, sharply toothed or pinnatifid, auricled on the upper side at the base. Sori very numerous, rather nearer the midrib than the edge; involucre flat, orbicular.

Synonyms.—A. pulcherrimum and A. waikarense, *Colenso;* A. venustum, *Hombr. and Jacq.;* A. proliferum, *R. Br.;* Polystichum

* Gr. *Aspidos*, a buckler or shield, from the shape of the involucre.

vestitum, *Presl.*; besides a host of other synonyms which have been given to varying forms in many parts of the world. To this also must be referred *Polypodium sylvaticum*, Col., described in the "Handbook Fl. N.Z.," page 350, and which in "Syn. Filicum" is included as a non-involucrate form.

Distribution.—Throughout the world; rare in the Arctic regions and Eastern N. America. Common throughout New Zealand, though in the N. Island chiefly in hilly and mountainous parts. There is considerable diversity as to the scaliness of the stipes and rachis even in our forms, and the typical European form differs a good deal from them in several respects; but innumerable intermediate gradations connect all the forms, and render specific separation impossible.

Though extremely common, this is a very handsome fern, and grows very readily under cultivation. It should be in every fernery.

2. A. richardi, *Hook.*

Rhizome short, stout, scaly. Stipes 6-12 in. long, rather stout, erect, clothed throughout—as is the rachis—with scattered, narrow, subulate, black scales. Fronds tufted, 6-18 in long, 4-9 in. broad, broadly ovate or deltoid, very coriaceous, dark-green above, glabrous or woolly and scaly below; pinnæ numerous, close, lanceolate, acuminate, deeply pinnatifid, or cut quite to the rachis into distinct lanceolate pinnules, which are themselves sharply toothed or pinnatifid, teeth often pungent. Sori in about 2 rows midway between the midrib and the edge; involucre flat, with a small black disk.

Synonym.—Polystichum aristatum, *Hook. f.*

Distribution.—Fiji. An abundant species throughout New Zealand; often found in rather open woods, but particularly partial to the sea coast. It is a very hardy fern.

3. A. oculatum, *Hook.*

Stipes 1 ft. long, firm, straw-coloured, clothed throughout with large, dark-brown, rigid, subulate scales, which are continued along the rachis and mixed with lax woolly hairs. Fronds tufted, coriaceous, 10-20 in. long, ovate-oblong or deltoid, acuminate, 3-pinnate, coriaceous; pinnæ numerous, 2-4 in. long, narrow ovate-lanceolate; pinnules alternate, lanceolate, cut nearly to the rachis into oblong-rhomboidal segments; the whole under-surface of the frond downy. Sori abundant, in 2 rows near the midrib; involucre orbicular, with a large black disk and narrow reddish margin.

This little-known fern is recorded from Akaroa and Nelson in the South Island, and the Wairarapa Valley in the North Island.

4. A. cystostegia, *Hook.*

Rhizome short, small. Stipes 2-4 in. long, stout, brown, shining, clothed with numerous lanceolate, pale-brown, membranous scales

which are $\frac{1}{4}$-$\frac{2}{3}$ in. long, and are continued (but of smaller size) up the rachis. Fronds tufted, 4-10 in. long, $1\frac{1}{2}$-2 in. broad, oblong-lanceolate, pale-green, soft, and placid, almost membranous; pinnæ distant below, crowded above, $\frac{1}{2}$-$1\frac{1}{2}$ in. long, ovate-deltoid, pinnatifid or pinnate; lower pinnules oblong-lanceolate, deeply lobed, the teeth blunt. Sori numerous, usually in two rows; involucres large, very membranous and convex, with the edge turned down all round.

Distribution.—Confined to the mountain ranges of New Zealand, occurring on Tongariro and Taranaki, and probably also on other mountain heights in the North Island. In the South Island it is found along the whole central chain at elevations of from 3,000 to 6,000 ft., in a great number of localities. It is extremely hardy, and can be cultivated with the greatest facility.

A. aristatum, *Swartz*,

included among New Zealand ferns in the "Handbook Fl. N.Z.," occurs on the Kermadec Islands, but in no other part of the N.Z. botanical region. It is a tropical fern, having a wide range from Japan in the N. to New South Wales in the S., and from Natal to Samoa.

5. A. capense, *Willd.* (Pl. III. fig. 3.)

Rhizome stout, creeping, elongated, covered with tawny, silky scales. Stipes 1-2 ft. long, firm, erect, greyish, densely scaly below. Fronds scattered, 1-3 ft. long, 12-18 in. broad, rigidly coriaceous, ovate-deltoid, pinnæ obliquely-deltoid, erecto-patent; pinnules 1-2 in. long, ovate or lanceolate, obtusely lobed or pinnatifid into oblong, obtuse, bluntly toothed or entire segments. Sori in 2 rows, nearly filling the segments; involucre large, orbicular, with a deep sinus.

Synonyms.—A. coriaceum, *Swartz;* A. cunninghamianum, *Colenso;* Polystichum coriaceum, *Schott;* Polypodium adiantiforme, *Forst.*

Distribution.—America, from Cuba to Patagonia; South Africa; Australia and Polynesia. Also in the Chatham Islands.

A common fern in most parts of New Zealand, ranging from N. Cape to Stewart Island, usually occurring in woods.

Genus XXI.—NEPHRODIUM,* *Br.* (Pl. III. fig. 4.)

Fronds pinnate or 2-4-pinnate; veins forked and free, rarely united. Sori sub-globose, dorsal, or terminal on the veinlets. Involucre cordate-reniform, attached by the sinus to the centre of the sorus, often deciduous.

I.—Lastrea. *Veins all free.*

Fronds pinnate.

Rhizome creeping. Fronds 1-2 ft. long, lanceolate ... ... 1. N. thelypteris.

* Gr. *Nephros*, a kidney, from the shape of the involucre.

Fronds 2-4-pinnate.

Rhizome creeping, elongated. Fronds scattered, 1-2 ft. long, glabrous or slightly pubescent	2. N. decompositum.
Rhizome short, stout. Fronds tufted, 7-10 in. long, glabrous or slightly pubescent	3. N. glabellum.
Rhizome short, stout. Fronds 1-2 ft. long, quite downy on both sides	4. N. velutinum.
Rhizome stout, creeping. Fronds 1-2 ft. long; stipes and rachis hispid with rough scaly hairs	5. N. hispidum.

II.—Eunephrodium. *Lower veinlets of contiguous groups united. Fronds pinnate in both species.*

Rhizome creeping. Fronds ovate-oblong, rather rigid; lower pinnæ not reduced	6. N. unitum.
Rhizome short, horizontal or suberect. Fronds oblong-lanceolate, rather membranous and flaccid, pubescent on both surfaces; lower pinnæ much reduced	7. N. molle.

1. N. thelypteris, *Desv.; var.* squamulosum, *Schlecht.*

Rhizome slender, wide-creeping. Stipes about 1 ft. long, slender, pale-coloured except at the base, which is blackish, quite naked or more or less covered with pale, convex, scattered scales. Fronds membranous, 1-2 ft. long, 3-6 in. broad, lanceolate; pinnæ subopposite, spreading, 1½-3 in. long, ½ in. broad, cut nearly to the rachis into entire linear-oblong lobes, which are broader in the sterile than in the fertile fronds; lower veinlets forked, upper simple. Sori numerous, small, not confluent, in rows near the recurved margin; involucres cordate-reniform.

Synonyms.—N. squamulosum, *Hook.;* Lastrea thelypteris, *Presl.;* L. palustris, *J. Sm.;* &c., &c.

Distribution.—The typical plant is common throughout the North temperate zone, while the local variety is also found in South Africa.

Rare in New Zealand, and very limited in its distribution. It occurs only in the north end of the North Island, from the Bay of Islands to Rotomahana, which is probably its most southerly habitat, and within these limits is of rather local occurrence. Maketu—on the E. Coast—is probably the locality where it is most abundant.

2. N. decompositum, *R. Br.*

Rhizome creeping, elongated, slender, more or less branched and covered with chaffy scales. Stipes 8-16 in. long, scaly at the base, finely pubescent. Fronds distant, solitary, membranous, villous or pubescent, 1-2 ft. long, 6-12 in. broad, ovate-acuminate; lowest pair of pinnæ much the largest, 5-7 in. long, 3-4 in. broad, obliquely-deltoid; upper pinnules lanceolate, pinnate or deeply pinnatifid, segments ovate with acutely-toothed lobes. Sori attached nearer the margin than the midrib.

Synonyms.—N. pentangularum, *Col.*; Aspidium decompositum, *Spreng.*; A. microsorum, *Endl.*; A. shepherdi, *Kunze*; A. acuminatum, *Lowe*; Lastrea decomposita, *J. Sm.*

Distribution.—Australia, Tasmania and Norfolk Island; also in the Chatham Islands.

This is a fern of very general distribution in New Zealand, occurring chiefly on the banks of rivers—according to Mr. Kirk. In the "Handbook Fl. N.Z." it has been confused with *N. glabellum.*

It is a species which grows readily under cultivation, and from its creeping habit requires only a few inches depth of well-drained loam, with a good supply of moisture.

3. N. glabellum, *A. Cunn.*

Rhizome short, stout, unbranched, clothed with the bases of old fronds. Stipes 3-6 in. long, scaly at the base, naked above, reddish. Fronds few, tufted on the summit of the rhizome, 7-10 in. long, 6-9 in. broad, deltoid, acuminate, slightly coriaceous, glossy; lowest pair of pinnæ 4-5 in. long, 2-3 in. broad, narrowly deltoid, rachis winged; pinnules pinnate or deeply pinnatifid, basal lobes overlapping; segments with obtusely-toothed lobes. Sori equidistant between the margin and the midrib.

Synonyms.—N. decompositum, *var.* pubescens, *Hook. f.*; N. decompositum, *var.* microphyllum, *Hook.*; Lastrea davallioides, *Brack.*; L. glabellum, *J. Sm.*; Aspidium glabellum, *Lowe.*

Distribution.—Australia, Fiji and Tahiti.

Generally distributed in forests throughout New Zealand. Botanists are indebted to Mr. Kirk for clearing up the confusion which had arisen regarding this and the preceding species. Though the points of difference between the two are not so very prominent as between many varieties of other species, yet these differences are very persistent, and intermediates do not appear to have been found.

A very easily cultivated fern, bearing transplantation remarkably well, and requiring very little care, except shelter from too much of the sun's rays.

4. N. velutinum, *Hook. f.* (Pl. III. fig. 4.)

Stipes 12-18 in. long, with subulate scales at the base, covered with bright-brown pubescence. Fronds 12-24 in. long, and nearly as broad, deltoid, acuminate, covered with silky, red-brown pubescence, which is most abundant on the rachises; lowest pair of pinnæ often 1 ft. long, deltoid; lowest pair of pinnules deflexed, much divided, larger than the others, which are close, lanceolate and cut to the rachis below into oblong acute, pinnatifid lobes; segments ovate, obtuse, toothed. Sori small, numerous; involucres hairy, usually ciliated with glandular hairs.

Synonyms.—Lastrea velutina, *Hook.;* Aspidium velutinum, *A. Rich.*

Distribution.—Apparently confined to New Zealand, unless a very similar form from N.E. Australia and Fiji can be referred to the same species.

This is a tolerably common species throughout New Zealand, though most abundant and luxuriant in the North Island. It becomes rather local and limited in its occurrence in South Canterbury and Otago districts.

5. N. hispidum, *Hook.* (Pl. III. figs. 4*a* and *b*.)

Rhizome long, stout, creeping, covered with brown scales. Stipes 12-18 in. long, stout, densely clothed—as are the rachises and costæ—with brownish-black spreading bristles. Fronds 12-18 in. long, 6-12 in. broad, subdeltoid, acuminate, coriaceous; pinnæ 3-6 in. long, lowest pair deltoid, others ovate or lanceolate acuminate; pinnules lanceolate, lowest pair the largest; segments lanceolate, cut down to a winged rachis into small oblong or linear, sharply-toothed lobes. Sori numerous; involucre flat, orbicular or reniform.

Synonyms.—Polystichum hispidum, *J. Sm.;* Polypodium setosum, *Forst.;* Aspidium hispidum, *Sw.;* Lastrea hispida, *Moore;* Aspidium setosum, *Schkuhr.*

Distribution.—Rare in Victoria.

This is the most abundant species of the genus in New Zealand, occurring in forests from North Cape to Stewart Island. It is also one of the most easily cultivated.

6. N. unitum, *R. Br.*

Rhizome stout, creeping. Stipes 12-18 in. long, brownish, glabrous or slightly chaffy at the base. Fronds 1-3 ft. long, 6-8 in. broad, ovate-oblong, simply pinnate, rather coriaceous, pubescent or glabrous; pinnæ 3-6 in. long, ½ in. broad, cut a third or half-way to the midrib into spreading, triangular, acute lobes. Veins pinnate in each lobe, with 6-8 veinlets on each side, united with the veinlets of adjoining lobes into a vein leading to the sinus. Sori near the end of the veinlets, usually in a row near the margin of the lobes;

involucre orbicular-reniform, or almost peltate, very small and deciduous.

Synonyms.—N. propinquum, *R. Br.;* Aspidium unitum, *Sw.;* A. gongylodes, *Schkuhr;* A. serra, *Schk.;* Polypodium unitum, *L.*

Distribution.—A common tropical fern occurring throughout the warmer parts of America, Africa, Asia, Australia and Polynesia.

In this colony it is extremely local and restricted in its range, being found only in the immediate neighbourhood of the hot springs and lakes of the North Island. It is found in immense profusion on the terraces at Rotomahana, and also at Otumakokori and Waipihi to the south, while it is also said to occur about hot springs near Maketu. Mr. Kirk suggests its probable occurrence in the hot spring district lying to the south of L. Taupo.

This species requires indoor cultivation, and thrives well in a firm soil composed of two parts peat, one loam and one sand.

7. N. molle, *Desv.*

Rhizome short and thick, horizontal. Stipes 1-2 ft. long, rather slender, green. Fronds tufted, 1-2 ft. long, 8-12 in. broad, lanceolate, pinnate, rather membranous and flaccid, pubescent on both surfaces; pinnæ spreading, 3-6 in. long, ¾ in. broad, cut about halfway to the midrib into oblong, obtuse, slightly falcate lobes; veins pinnate, with 6-8 veinlets on each side, the lowest uniting in a veinlet running to the sinus. Sori usually in two rows, distant from the midrib; capsules naked.

Synonyms.—Polypodium molle, *Forst.;* Aspidium molle, *R. Br.;* A. nymphale, *Forst.;* besides a number of other names given to forms of the same variable plant in other parts of the world.

Distribution.—Common in tropical America and Africa; also in Southern Asia and Australia.

It is only known certainly from one locality in New Zealand—viz., on the banks of the Otumakokori or *boiling river*, at the foot of the Paeora Range in the North Island, and there it occurs sparingly. In the "Handbook Fl. N.Z." it is said to be found at Rotomahana, and has also been recorded from Whangarei by Mr. Robert Mair, but both localities are disputed by Mr. Kirk.

Like the last, this is essentially a tropical fern, and requires the shelter of a house for its successful growth—at least in most parts of the South Island. It is an easily cultivated species, and is a familiar plant in English ferneries.

Genus XXII.—NEPHROLEPIS,* *Schott.* (Pl. III. fig. 5.)

Fronds pinnate, coriaceous; pinnæ articulated at the base, often deciduous, with minute white waxy dots on the upper surface, veins

* Gr. *Nephros*, a kidney, and *lepis*, a scale, from the shape of the involucre.

free. Sori dorsal, arising from the apex of the upper branch of a vein, generally near the edge. Involucre reniform or rounded.

1. N. cordifolia, *Presl.*

Rhizome almost wanting, emitting long wiry fibres. Stipes stout, wiry, 1-4 in. long, slightly scaly. Fronds tufted, 1-3 ft. long, 1½-2 in. broad, linear-lanceolate, acuminate, rather coriaceous; pinnæ ½-1 in. long, close-set, oblong, obtuse, entire or slightly crenate on the margin, the under side rounded or cordate at the base, the upper distinctly auricled. Sori in a single row, half-way between the margin and midrib; involucre firm, reniform, brown or blackish, oblique or opening towards the outer edge.

Synonyms.—N. tuberosa, *Presl.;* N. pectinata, *Schott;* Aspidium cordifolium, *Swartz;* A. tuberosum, *Bory*, &c.

Distribution.—Common in the tropical regions of the New and Old World; also in N.S. Wales and Queensland.

This fern is another of those tropical species which apparently were at one time spread over the northern parts of the North Island, but are now only able to maintain their ground where the hot springs keep up a sort of artificial tropics. It occurs only in two localities in New Zealand—viz., at Otumakokori and at Tapuaeharuru, both in the hot lake district. In the former place it is abundant, but only in such spots as are influenced by the warm water of the river.

With the shelter of a greenhouse, it may be easily cultivated, requiring abundance of water and good drainage. It is a very elegant fern.

In tropical America and India the fibres of the rhizome bear ovoid, scaly tubers, which constitute an article of food.

GENUS XXIII.—POLYPODIUM,* *L.* (Pl. III. figs. 6 and 7, and frontispiece.)

Rhizome usually creeping, sometimes erect or almost wanting. Fronds simple, pinnate or compound; venation various. Sori round or rarely oblong, dorsal, without an involucre.

The largest genus of ferns, but broken up by many authors into several distinct genera. Thus the ten species recorded below belong —according to Mr. J. Smith's classification—to no less than seven genera.

(I. *Phegopteris*). — *Veins free. Fronds 2-3-pinnate, with pinnatifid pinnules;* stipes, rachis and surface with reddish glandular pubescence... 1. P. punctatum.

* Gr. *Polys*, many, *pous*, a foot, from the numerous branches or stipes of some of the species.

(II. *Goniopteris*). — *Veins pinnate, the lower veinlets of contiguous groups joining.* Fronds pinnate, membranous, glabrous ... ... 2. P. pennigerum.

(III. *Eupolypodium*).—*Veins free. Fronds entire, pinnatifid or pinnate.*

Rhizome short, creeping. Fronds entire. Sori oblong or linear (*Grammitis*) ... 3. P. australe.

Rhizome almost 0. Fronds pinnatifid ... 4. P. grammitidis.

Rhizome long, slender, climbing. Fronds pinnate, pendulous (*Arthropteris*) ... 5. P. tenellum.

(IV. *Niphobolus*).—*Veins anastomosing, hidden in the frond.*

Fronds entire, coriaceous, clothed below with dense, stellate tomentum ... 6. P. serpens.

(V. *Phymatodes*).—*Veins anastomosing, with free-spreading veinlets in the areoles. Fronds glabrous.*

Rhizome short. Fronds tufted, quite entire, lanceolate ... ... 7. P. cunninghamii.

Rhizome slender, climbing, covered with squarrose scales. Fronds entire or pinnatifid, membranous ... ... 8. P. pustulatum.

Rhizome stout, climbing, covered with appressed scales. Fronds entire or pinnatifid, coriaceous ... ... 9. P. billardieri.

Rhizome thick, creeping, covered with shaggy, spreading scales. Fronds large, thinly coriaceous, pinnatifid above, pinnate below; lobes long, linear. Sori rather small ... ... 10. P. novæ-zælandiæ.

1. P. punctatum, *Thunberg; var.* rugulosum.

Rhizome stout, creeping, more or less villous or hispid and scaly. Stipes 1-2 ft. long, firm, and together with the rachises red- or purple-brown and covered with glandular pubescence. Fronds scattered, ½-4 ft. long, 3 in. - 2 ft. broad, also more or less glandular and viscid, herbaceous; pinnæ in distant pairs, oblong, acuminate; pinnules close, ½-¾ in. long, oblong, or linear-oblong, obtuse, crenate or pinnatifid with rounded segments, veins pinnate with free-forked branches. Sori orbicular in two rows near the margin of the pinnules, often covering the whole under-surface.

A variable fern, very difficult to distinguish from *Hypolepis tenuifolium;* in the latter, however, the sori are strictly on the margin, and are more or less covered by the recurved tooth of the frond or

pseudo-involucre; while in the present species the sorus is at some little distance from the margin and on a veinlet. When the fructification is young, these characters are usually sufficiently distinctive, but in older specimens this is not the case. Large specimens are usually 3-pinnate, or rarely 4-pinnate at the base.

Synonyms.—P. rugulosum, *Labill.;* P. viscidum, *Spreng.;* Phegopteris rugulosa, *Fée;* Cheilanthes ambigua, *A. Rich.*

Distribution.—The typical form is widely distributed, occurring in great part of S. America, Japan, many of the Pacific Islands, Malay Archipelago, India, Australia, and several islands of the Indian and South Atlantic Oceans.

This is a very common fern throughout the whole of New Zealand, occurring chiefly in woods or on their margins, and springing up freely in bush clearings. It thrives very readily in cultivation, but is a little difficult to transplant successfully, unless very young plants are lifted. Once established, it spreads rapidly.

2. P. pennigerum, *Forst.* (Pl. III. fig. 6.)

Rhizome 6-12 in. high, erect, woody and covered with the bases of old stipes. Stipes 6-12 in. long, stout, glabrous, scaly at the very base. Fronds tufted, 2-3 ft. high, glabrous, membranous, pinnate, except the top, which is pinnatifid; pinnæ 4-8 in. long, $\frac{2}{3}$ in. broad, cut about half-way down into broad, blunt, slightly falcate lobes, which are entire or faintly crenated on their margins; veinlets 6-8 on a side, free, except the lowest pairs, which unite at the sinuses. Sori numerous on the veinlets, nearer the costa than the margin.

Synonyms.—Goniopteris pennigera, *J. Sm.;* G. forsteri, *Moore;* Aspidium pennigerum, *Swartz.*

Distribution.—Confined to New Zealand and the Chatham Islands, though closely allied to *P. tetragonum*, Sw., an American species. It is common from N. Cape to Foveaux Straits, occurring chiefly in woods and on the margins of streams. As a rule, it does not occur at any great distance from the coast. Mr. Potts records specimens with a trunk, or rootstock, 27 in. long, and 9 in. in circumference, bearing fronds 5-6 ft. long. It is an easily cultivated species, thriving best in rich vegetable loam with a plentiful supply of water, and in a shaded locality.

3. P. australe, *Mettenius.*

Rhizome short, creeping, scaly, forming a dense tuft. Fronds tufted, 1-12 in. long, simple, linear or oblanceolate, subacute or obtuse, coriaceous, gradually tapering to a very short winged stipes, naked or slightly ciliate on the margins; veins free, concealed in the frond, diverging from the midrib. Sori oblong or linear, oblique, close, in 1 row on each side of the midrib.

Synonyms.—Grammitis australis, *R. Br.*; G. billardieri, *Willd.*; G. ciliatum, *Col.*; G. rigida and G. humilis, *Homb. et Jacq.*; Polypodium diminutum, *Baker.*

Distribution.—Southern extremity of America and adjoining islands, Tristan d'Acunha, Australia, New Caledonia.

Very common in New Zealand from N. Cape to Stewart Island, usually occurring on tree trunks, rocks, &c. This is a somewhat difficult fern to cultivate, but well-rooted plants—if gathered with portions of the wood or bark to which they are attached in their native habitats—may be very effectively grown in baskets or wire cylinders filled with peat; or they may be planted in shallow pans filled with loose peaty soil, and kept rather moist.

4. P. grammitidis, *R. Br.*

Rhizome very short, scaly. Stipes 1-2 in. long, slightly winged. Fronds tufted, 4-12 in. long, coriaceous, glabrous, linear-oblong or lanceolate, pinnatifid to the rachis, almost pinnate; pinnæ ½-2 in. long, the longest in the middle of the frond, linear, entire or pinnatifid, decurrent at the base; veins sunk in the frond, simple or forked. Sori oblong, numerous, usually 1 to each lobe.

Synonyms.—Grammitis heterophylla, *Labill.*; Xiphopteris heterophylla, *Spreng.*; Ctenopteris grammitidis.

Distribution.—Tasmania and Victoria. Also found in the Chatham Islands.

A common fern in New Zealand woods, where it grows on the trunks of trees. It ranges from N. Cape to Stewart Island, and ascends to over 3,000 ft. in both islands. It is often very variable in form, the fronds being sometimes only lobed below and toothed above, while others occur distinctly bipinnatifid. The mode of cultivation recommended for the preceding species is applicable for this also, though it grows more readily under pot culture in the moist atmosphere of a fern-house.

5. P. tenellum, *Forst.*

Rhizome long, slender, woody, scaly when young, climbing high trees. Stipes 2-3 in. long, slender, smooth and polished, jointed near the base. Fronds scattered, pendulous, 1-2 ft. or more long, lanceolate, pinnate, membranous and bright-green; pinnæ alternate, distant, 2-3 in. long, linear-lanceolate, entire or sinuate, unequal at the base; veins 2-3, forked, one fork bearing the sorus, the other again forked. Sori orbicular, small, forming a row near the margin.

Synonyms.—Arthropteris tenella, *J. Sm.*; Polypodium filipes, *Moore.*

Distribution.—Australia and New Caledonia.

In New Zealand it is almost confined to the North Island, where it is plentiful in the woods. The only locality in the South Island

in which it has been found is Banks' Peninsula, and it is very rare there.

6. P. serpens, *Forst.*

Rhizome wide-creeping, slender, firm, covered with narrow acuminate reddish scales. Stipes ½-3 in. long, firm. Fronds simple, entire, of two forms, the barren obovate or orbicular, 1-3 in. long, the fertile longer and narrower, 2-6 in. long, all thick and coriaceous, and coated below with a thick whitish or rusty, stellate tomentum; veins hidden. Sori large, numerous, irregularly scattered, often becoming confluent and covering the upper half of the frond.

Synonyms.—P. rupestre, *Br.*; P. stellatum, *A. Rich.*; P. elæagnifolium, *Bory.*; P. confluens, *Hook.*; Niphobolus rupestris, *Kaulf.*; N. confluens, *Bail.*

Distribution.—Westwards to Australia; eastward through the South Pacific Islands to Tahiti. Also in the Chatham Islands.

A most abundant fern in New Zealand from N. Cape to Stewart Island, and ranging from sea-level to between 3,000 and 4,000 ft. It is always found creeping on the trunks of trees or on rocks, and is an easily cultivated species. Its stellate hairs are favourite microscopic objects.

7. P. cunninghamii, *Hook.*

Rhizome short, creeping, covered with large, dull-brown, lanceolate scales. Fronds tufted, glabrous, coriaceous, 6-12 in. long, ½-¾ in. broad, linear-lanceolate, acuminate, quite entire, gradually narrowing to a short, winged stipes; veins anastomosing, without free veinlets in the areoles. Sori large, prominent, round or oblong in one row nearer the midrib than the edge.

Synonyms.—P. attenuatum, *Hook.*; Dictymia lanceolata, *J. Sm.*

Distribution.—New Hebrides.

In New Zealand this fern is more limited in its range than others of the same group. It is common in the North Island, ascending to 2,500 ft.; in the South Island, we are informed on the authority of Banks and Solander in Hooker's "Handbook," it occurs as far south as Akaroa. It does not appear to have been gathered again at the last-named locality. According to Mr. Potts it grows near Nelson, which is the only other locality I know in the South Island. It usually grows on the trunks of trees or on rocks, but is sometimes found with a terrestrial habitat on the banks of streams.

8. P. pustulatum, *Forst.*

Rhizome long, woody, slender, copiously-branched, climbing tall trees, clothed with linear, dark-brown, squarrose scales. Stipes 1-3 in. long, slender, glabrous. Fronds variable, firmly membranous, sometimes entire, 3-9 in. long, ¼-⅔ in. broad, gradually narrowing to both ends, or 8-18 in. long and more or less deeply pinnatifid into

distant, lanceolate, acuminate segments; veins with large, irregular areoles and copious free veinlets. Sori rather small, immersed, in one row, nearer the margin than the midrib.

Synonyms.—P. membranifolium, *Br.*; P. scandens, *Forst.*; Phymatodes pustulata, *Presl.*; Pleopeltis pustulata, *Moore.*

Distribution.—Australia, from Victoria to Queensland, and in Norfolk Island. Also in the Chatham Islands.

A widely-ranging species in both islands of New Zealand; abundant in the North Island and northern parts of the South Island, but not very common in Otago. At the Thames it is abundant up to 2,000 ft. It is a fragrant fern, and was used by the Maories for scenting oil, &c.

9. P. billardieri, *Br.* (Pl. III. fig. 7, and frontispiece.)

Rhizome stout, woody, creeping widely, with ovate-acuminate appressed scales. Stipes 4-8 in. long, firm, glossy. Fronds varying in shape, 3-18 in. long, lanceolate or oblong and quite entire, or more or less deeply pinnatifid, with lanceolate or linear lobes; erect or pendulous, coriaceous; glabrous; veins irregular, with free veinlets in the areoles. Sori large, immersed, in one row intermediate between the margin and midrib, or nearer the former.

Synonyms.—P. scandens, *Labill.*; P. diversifolium, *Willd.*; Phymatodes billardieri, *Presl.*; Niphobolus glaber, *Kaulf.*

Distribution.—Tasmania, Australia, and apparently New Caledonia. Also in the Chatham, Auckland and Campbell Islands.

An abundant fern throughout New Zealand, ranging from N. Cape to Stewart Island, and ascending to 3,000 ft. Like the last, it is almost an epiphyte, but is frequently found growing on rocks or even on the ground. It is most readily cultivated.

10. P. novæ-zælandiæ, *Baker.*

Rhizome stout, woody, as thick as the forefinger, densely clothed with large tawny ovate-lanceolate spreading scales. Stipes 6-12 in. long, glabrous, erect, glossy. Fronds 1-2 ft., rarely 3-4 ft. long, 8-12 in. broad, cut above nearly to the rachis into numerous linear acuminate lobes, below almost pinnate; lobes 5-20 on each side, 4-8 in. long, ½ in. wide, entire, thinly coriaceous; veins indistinct, with large areoles and free included veinlets. Sori rather small, in one row, nearer the margin than the midrib.

Distribution.—Only found in the forest regions of the North Island. First discovered (in 1877) by Mr. T. F. Cheeseman on Pirongia, and again on Karioi, between Raglan and Aotea, at about 2,000 ft. elevation. Apparently also the same species has been found by Mr. H. C. Field in the forest country to the west of Ruapehu. It grows chiefly on rotten logs, seldom on the ground, but apparently does not climb trees.

GENUS XXIV.—NOTOCHLÆNA,* *Br.* (Pl. III. fig. 8.)

Fronds 2- or 3-pinnate, usually small, stiff, erect; pinnæ small. Veins forked from the midrib or from the base of the segment. Sori marginal, at first oblong or rounded, ultimately confluent into a continuous marginal line, without a distinct involucre, but with the margin of the frond frequently inflexed.

A small genus differing from *Cheilanthes* only in the absence of a distinct involucre; connected with it by intermediate gradations. The original name *Notholæna* of Brown's has been altered by most botanists to *Notochlæna.*

1. N. distans, *Br.*

Rhizome very short, stout, scaly. Stipes 1-5 in. long, wiry, chestnut-brown, more or less clothed with linear, reddish scales. Fronds tufted, erect, rigid, 6-9 in. long, ¾-1 in. broad, linear, 2-pinnate, upper surface dark-green and villous, lower surface and rachis covered with linear, reddish scales; pinnæ opposite, ½-1 in. long, deltoid or ovate, the lower distant; pinnules in few pairs, lower pinnatifid, with recurved margins. Sori forming an almost continuous line.

Synonym.—Cheilanthes distans, *A. Brown.*

Distribution.—Tasmania, Australia and New Caledonia.

A local fern in New Zealand. In the North Island it occurs chiefly in the volcanic districts, growing on basaltic rocks, for which it seems to have a preference. Thus it is abundant at Rangitoto, Titirangi and some other parts of the Auckland district, north to Whangarei. In the South Island it has been recorded from several localities in the Canterbury district, ascending to 3,000 feet. It does not appear to be at all common, however. It is a very hardy species, thriving in dry, stony soil under a blazing sun.

GENUS XXV.—GYMNOGRAMME,† *Desv.* (Pl. III. fig. 9.)

Rhizome short and tufted. Fronds pinnate or 2- or 3-pinnate; veins free or anastomosing. Sori linear or oblong, simple or forked, without any involucre, on the veins diverging from the midrib.

Perennial.—Fronds usually 2-pinnatifid, covered underneath with scaly hairs	1. G. pozoi.
Annual.—Fronds 2- or 3-pinnate, thinly-membranous, glabrous	2. G. leptophylla.

1. G. pozoi, *Kunze; var.* rutæfolia, *Br.* (Pl. III. fig. 9*a.*)

Rhizome short and stout. Fronds tufted, 1-5 in. long, linear or ovate-oblong, obtuse, membranous, densely covered below with soft,

* Gr. *Nothos*, spurious; *chlæna*, a cloak; from the imperfect involucre.

† Gr. *Gymnos*, naked; *gramma*, a line; from the naked linear sori.

brown, scaly hairs, some of which are glandular and are continued down the slender, brittle stipes; pinnæ obliquely ovate or almost fan-shaped, $\frac{1}{4}$-$\frac{1}{2}$ in. long and broad, with a few deep, blunt lobes; veins flabellate. Sori chiefly in the middle of the pinnæ, sometimes almost covering the whole surface.

Synonyms.—G. rutæfolia, *Hook.*; G. papaverifolia, *Kunze*; G. subglandulosa, *Hook. and Gr.*; G. alpina, *T. H. Potts*; Grammitis rutæfolia, *R. Br.*

Distribution.—The typical form only occurs in South-eastern Europe, but var. *rutæfolia* ranges over the whole of Australia and Tasmania. A variety with more deeply cut pinnæ (*G. papaverifolia*) occurs in Chili.

The range of the species in New Zealand is very restricted. It was originally found by Colenso "on cliffs near Cook Straits," but I do not know the exact locality. It also occurs sparingly on the Southern Alps, at about 3,000 ft. elevation. This alpine form has recently ("Trans. N.Z. Inst.," vol. x. p. 361) been described by Mr. Potts as a new species.

2. G. leptophylla, *Desvaux.* (Pl. III. fig. 9.)

A slender annual. Stipes 1-4 in. long, slender, glossy, chestnut-brown. Fronds tufted, perfectly glabrous and thinly membranous in texture, 2-6 in. long, 1-1$\frac{1}{2}$ in. broad, ovate or deltoid, the outer smaller and often barren, 2- or 3-pinnate; pinnæ obovate-cuneate, cut to the centre into obtuse linear or oblong lobes; veins flabellate. A single vein and linear sorus carried into each ultimate lobe.

Synonym.—Grammitis novæ-zælandiæ, *Colenso.*

Distribution.—Widely dispersed over the temperate and sub-tropical regions of both worlds, occurring in various parts of Europe, Africa and Asia; also in the Andes, and over great part of Australia and Tasmania.

Occurring rather locally in various districts of New Zealand, chiefly in hilly or rocky places at no great distance from the sea. In the North Island it is found commonly at the head of Manukau Harbour; also, more rarely, near Auckland, near Napier and Cape Kidnappers on the E. Coast. It also occurs about the Thames and near Wellington. In the South Island it is abundant near Lyttelton, and in some other parts of the Canterbury district. In Otago it occurs in the Upper Clutha district, near Cromwell, and sparingly near Dunedin.

Genus XXVI.—TODEA,* *Willd.* (Pl. III. fig. 10.)

Rhizome erect. Fronds tufted, large, 2- or 3-pinnate. Capsules 2-valved, globose, opening across the apex, furnished with a short,

* In honour of Henry Julius Tode, a mycologist of Mecklenburg.

obscure, horizontal ring, collected in sori or clustered irregularly on the under-surface of the segments.

I.—Eutodea. *Texture of the frond coriaceous.*

Fronds 2-8 ft. long, 2-pinnate ... ... 1. T. barbara.

II.—Leptopteris, *Presl. Texture of the frond thinly-membranous and pellucid.*

Lowest pinnules as long as the others, so that the base of the frond is truncate ... ... 2. T. hymenophylloides.

Lowest pinnules smaller than those above, so that the frond gradually narrows to its base ... ... 3. T. superba.

1. T. barbara, *Moore.* (Pl. III. fig. 10.)

Stem erect, often forming a stout trunk, 4 or 5 ft. high. Stipes 1 ft. long or more, stout, pale-brown, quadrangular, glabrous and smooth. Fronds 3-8 ft. long, 2-pinnate, glabrous, coriaceous; pinnæ linear, erecto-patent, 6-9 in. long, $1\frac{1}{2}$-2 in. broad; pinnules close, alternate, linear, 1-$1\frac{1}{2}$ in. long, $\frac{1}{8}$-$\frac{1}{4}$ in. broad, crenate or serrate on the margins, the upper with sessile (often decurrent) bases. Sori dense on the lower pinnules of the lower pinnæ, when mature filling up nearly the whole under-surface.

Synonyms.—T. africana, *Willd.;* T. rivularis, *Sieb.;* Osmunda barbara, *Thun.*

Distribution.—Australia, Tasmania and S. Africa.

Only found in New Zealand in the North Auckland district, where it is not uncommon from N. Cape to Bay of Islands and Whangaroa. Mr. T. H. Potts states that in sheltered spots this is a sufficiently hardy fern to stand the winter of Canterbury, and that he has grown it in the open fernery for some years.

2. T. hymenophylloides, *Rich. and Less.*

Rhizome short, rarely as much as 2 ft. high, stout, creeping or erect. Stipes 6-12 in. long, erect, glabrous or more or less tomentose. Fronds tufted, 1-2 ft. long, 6-12 in. broad, ovate-lanceolate or deltoid, 2-pinnate, pellucid-membranous; pinnæ close, linear-lanceolate, 4-6 in. long, $\frac{3}{4}$-$1\frac{1}{4}$ in. broad, the rachis winged towards the apex only, the lowest as long as those above them; pinnules close, shortly stalked, linear-oblong, $\frac{1}{2}$-$\frac{3}{4}$ in. long, $\frac{1}{4}$ in. broad, cut almost to the rachis into simple or forked linear segments.

Synonyms.—T. pellucida, *Hook.;* Leptopteris hymenophylloides, *Presl.*

Distribution.—Confined to New Zealand, where it is common in all wooded parts. This fern is easily cultivated, provided it be

grown in a shady spot, protected from wind. It is one of the most beautiful species we have, and should be found in every fernery. In collecting specimens for the herbarium, the fronds should be placed between drying papers as soon as gathered, as they quickly shrivel and become so curled up as to lose their beauty. This remark is even more applicable to the next species.

3. T. superba, *Colenso.* (*Crape-fern.*)

Rhizome erect, woody, 12-18 in. high, crowned by the tufted fronds. Stipes 2-3 in. long, naked; rachises with dense tomentum. Fronds erect, 2-4 ft. long, 5-10 in. broad in the middle, 3-pinnatifid; pinnæ crowded, 3-5 in. long, linear-lanceolate, the lower ones becoming gradually shorter; pinnules crowded, sessile, $\frac{1}{4}$-$\frac{3}{8}$ in. long, linear-oblong, cut nearly to the rachis into linear simple or forked segments, which are often densely crowded and crisped, so as to completely hide the rachis.

Synonym.—Leptopteris superba, *Hook.*

Distribution.—Like the last, with which it is closely connected by intermediates, this species is confined to New Zealand (ranging to the Auckland Islands in the S.), but is somewhat local in its occurrence. It is found chiefly in the mountain districts of the North Island, from Pirongia in the N. to Wellington in the S., at elevations varying from 2,000 to 3,500 ft. In the South Island, and particularly along the West Coast forest regions, it is much more common, up to 3,000 ft. It is rare in Canterbury Province and local in the eastern part of Otago, but in the large forest-covered districts near Invercargill it is common at about sea-level. The delicate and fragile nature of the fronds renders this fern unsuitable for out-door cultivation, as the least breath of dry wind shrivels it up; it may grow, but it will not thrive unless in the shelter and shade of a suitable house. When growing, this is one of the most beautiful of the New Zealand species, but the thicker and more crisped the fronds, the sorrier do they look in the herbarium.

Genus XXVII.—SCHIZÆA,* *Smith.* (Pl. III. fig. 11.)

Rhizome short, creeping. Fronds erect, linear, simple or forked, usually terminated by separate fertile segments arranged in a close comb-like manner; stipes erect, rigid. Capsules in 2 rows, sessile on one side of the pinnules, ovoid or globular, 2-valved, opening laterally, crowned by a complete ring.

Fronds terete or subterete, not forked.

Fronds 1-3 in. long; fertile segment $\frac{1}{4}$ in. long; spikes about 6 ... ... 1. S. australis.

* Gr. *Schizo,* I split, from the divided fronds.

Fronds 4-12 in. long; fertile segment $\frac{1}{2}$-1 in. long; spikes 10-20 ... ... 2. S. fistulosa.

Fronds terete or semiterete, forked.

Fronds 6-18 in. long; once or twice forked ... ... 3. S. bifida.

Fronds flattened, flabellately forked above ... ... 4. S. dichotoma.

1. S. australis, *Gaudichaud.*

"Stipes dense, very short, dark chestnut-brown, passing gradually into the wiry subterete frond, which is 1-2 in. long, about $\frac{1}{4}$ line thick, simply channelled in front; fertile segment suberect, $\frac{1}{4}$ in. long, unilateral, with about 6 short stout nearly spreading spikes on each side, the lowest $\frac{1}{8}$ in. long."

Synonyms.—S. palmata and S. pectinata, *Hombr. et Jacq.*; S. fistulosa, *var.* Australis, *Hook. f.*

Distribution. — Falkland and Auckland Islands, which latter habitat being in the New Zealand region and frequently visited (which the Kermadec Islands are not) by whalers, sealers, and others, I have thought it advisable to include this little Antarctic species in my list. I have not seen the plant, the description being taken from the "Synopsis Filicum."

2. S. fistulosa, *Labill.* (Pl. III. fig. 11*a*.)

Stipes simple, terete, deeply grooved in front, chestnut-brown, passing gradually into the frond, which is 4-12 in. long (rarely as much as 20 in.), rigid, rush-like, $\frac{1}{40}$-$\frac{1}{20}$ in. diam.; fertile segment $\frac{1}{2}$-1 in. long, suberect, with 8-20 close slender pinnules on each side, $\frac{1}{8}$-$\frac{1}{4}$ in. long, whose edges are torn and toothed.

Synonyms.—S. valdiviana, *Phil.*; S. bifida, *Hook. f.* (in part); S. propinqua, *A. Cunn.* (in part).

Distribution.—Australia, Tasmania, New Caledonia, Chili and Madagascar; also in Chatham Islands.

A plant of wide range, but of local occurrence in New Zealand, and usually found growing in miserably cold, wet, or poor soils. In the North Island, it occurs from Whangarei and Bay of Islands to the Thames, chiefly in Manuka scrub, and in the latter locality ascending to 2,000 ft. In the South Island, it has been gathered in Canterbury and on the W. Coast of Otago. I have myself gathered it, in a stunted condition, in peaty swamps in Stewart Island, at the head of Paterson Inlet.

The plants of this genus are most difficult to cultivate, and, with one or two exceptions, are not to be found even in the best-stocked ferneries of England. Our species form no exception to this rule.

3. S. bifida, *Swartz.*

Stipes dense, chestnut-brown, passing gradually into the terete frond, which is 6-18 in. long, once forked at or below the middle, rarely forked again or undivided, wiry or rush-like, narrowly-winged, midrib scabrous, about $\frac{1}{30}$ in. thick; fertile segments suberect or recurved, $\frac{1}{2}$-$\frac{3}{4}$ in. long, fruiting-spikes 10-20, slender, closely-packed, erecto-patent, the lowest $\frac{1}{4}$-$\frac{3}{8}$ in. long, margins ciliated.

Distribution.—Tasmania and Australia.

In New Zealand this species is confined to the N. Island, and ranges from Whangarei and the Bay of Islands to the Thames, where it ascends to 2,000 ft. It is usually to be found on wretchedly cold, poor clay soils.

4. S. dichotoma, *Swartz.* (Pl. III. fig. 11.)

Stipes 6-12 in. long, firm, erect, glossy, channelled on the face above. Fronds fanlike in outline, 6-9 in. each way, flattened, many times dichotomously forked, the ultimate divisions $\frac{1}{20}$ - $\frac{1}{12}$ in. broad. Fruiting segments $\frac{1}{4}$-$\frac{1}{2}$ in. long, with 4-10 very narrow and contiguous fruiting spikes, $\frac{1}{12}$ - $\frac{1}{4}$ in. long, with laciniate margins.

Synonyms.—S. forsteri, *Spreng.;* S. cristata, *Willd.;* &c.

Distribution.—Mauritius, Reunion, India, Malacca, Philippines, Australia, Polynesian Islands and tropical America.

Only found in the Kauri forests of the North Island, from Auckland to Bay of Islands; and on some of the islands in the Hauraki Gulf. It is said to have been gathered at Banks' Peninsula, but the locality is not a probable one.

Genus XXVIII.—LYGODIUM,* *Swartz.* (Pl. IV. fig. 1.)

Climbing ferns, with long twining stems. Fronds dichotomously branched, usually in divaricate shortly-stalked pairs; veins free, forked. Capsules solitary in the axils of imbricating scales or involucres, which are arranged in distichous spikes projecting from the frond.

1. L. articulatum, *A. Rich.* (*Manga-Manga.*)

Rhizome slender, covered with brown scales. Stems 50-100 ft. long, climbing to the tops of forest-trees. Fronds quite glabrous, rather coriaceous, much branched; primary petiole $\frac{1}{4}$ - $\frac{1}{2}$ in. long, secondary 1-3 in. long; barren pinnules twice forked, each bearing 4 linear or oblong segments, which are 2-3 in. long, about $\frac{1}{2}$ in. broad, and are jointed on to a short petiole; fertile pinnules short, many times dichotomously divided, with densely-clustered short spikes.

* Gr., *Lygodes*, flexible or pliant.

Distribution.—Confined to New Zealand, where it occurs (in the North Island only) from N. Cape to the latitude of E. Cape, ascending at the Thames, and on Pirongia, to about 2,500 ft. It is only found in the bush or on its outskirts.

The twining stems have long been used by the Maories for all purposes for which rope is now used; they are very tough and enduring.

This fern grows well under cultivation, but requires the shelter of a greenhouse in most parts of the South Island. It should have a good firm mould to grow in, and lattice or trellis-work to grow upon, which it will soon cover with its elegant fronds.

GENUS XXIX.—MARATTIA,* *Smith.* (Pl. IV. fig. 2.)

Rhizome large, thick and tuberous. Stipes very stout, jointed to the rhizome, and furnished at the base with a pair of large flap-like auricles or stipules. Fronds large, 2- or 3-pinnate. Capsules completely united in 2 rows in oblong, boat-shaped sori (*synangia*), which are placed in a continuous row near the margins and terminating the veins, and which open by slits down their inner faces, exposing a number of transverse openings leading to the cells containing the spores. In the only N.Z. species the sorus is furnished with an obscure fimbriated inferior involucre.

1. M. fraxinea, *Smith.*

Stipes 1-2 ft. long, 1-1½ in. thick, smooth, deciduously scaly and swollen in the lower part. Fronds 6-12 ft. long, deltoid, coriaceous, dark-green, 2-pinnate, rarely 3-pinnate; pinnæ 1-2 ft. long; pinnules 3-8 in. long, ½ - 1½ in. broad, lanceolate or linear-oblong, acuminate, serrate or entire, rounded or cuneate at the base; veins parallel, simple or forked. Sori $\frac{1}{20}$ - $\frac{1}{12}$ in. long, submarginal, with 6-12 capsules on each side.

Synonym.—M. salicina, *Smith*; &c., &c.

Distribution.—Spread over the tropical regions of the Old World, and extending south beyond the tropics in Africa, Australia and New Zealand. In this colony it only occurs in the forests of the North Island, ranging from Taranaki on the W.—and which is also probably its southern limit—to the North Cape. It is only found in a few widely-separated localities, and is fast becoming very rare.

The rhizome, or rootstock, is a most peculiar feature of this fine fern. According to Mr. Buchanan, "it is composed of an irregular agglomerated mass of thick fleshy scales, each scale formed by the enlargement of a stipe base—the stipe separating by an articulation above the swelling." It contains a large amount of starch, and was formerly an important article of food—under the name of *Para*—

* In honour of J. F. Maratti, an Italian writer on Ferns.

among the Maories; it is still eaten, probably only when nothing better can be obtained.

This fern thrives well under cultivation, but requires protection from frost. It should have a deep loamy soil, with good drainage, but plenty of water. It is readily propagated from the scales of the rootstock, which can be separated and planted much after the manner of potatoes.

ORDER II.—OPHIOGLOSSACEÆ.

(The characters of the Order are given at p. 17.)

GENUS I.—OPHIOGLOSSUM,* *L.* (*Adder's-tongue.*)
(Pl. IV. fig. 3.)

Stipes solitary, erect, bearing a single frond and a fruiting spike. Frond leaflike, entire, veins netted. Capsules connate, sessile in 2 rows along the rachis, bursting transversely.

Rootstock slightly tuberous. Frond 1-3 in. long	1. O. lusitanicum.
Rootstock not tuberous. Frond 3-12 in. long	2. O. vulgatum.

1. O. lusitanicum, *L.*

Rootstock slightly tuberous. Frond 1-3 in. long, the sterile portion ½-1 in. long, placed below the centre, linear-lanceolate or oblong to ovate, obtuse, rarely acute, narrowed below, no midrib, veins indistinct; fertile spike ¼-½ in. long.

Synonyms.—O. gramineum, *Willd.*; O. coriaceum, *A. Cunn.*; O. minimum, *Colenso*; and many others.

Distribution.—Southern Europe, Africa, India, Australia.

Not uncommon in grassy land throughout both islands of New Zealand.

2. O. vulgatum, *L.* (Pl. IV. fig. 3.)

Rootstock not tuberous. Frond 3-12 in. long, the sterile portion 2-4 in. long, ¾-2 in. broad, placed about the middle, ovate or ovate-oblong, midrib and veins more or less distinct; fertile spike 1-2 in. long, upon a peduncle about twice as long.

Synonyms.—O. costatum, *R. Br.*; O. elongatum, *A. Cunn.*; &c.

Distribution.—Over the whole north temperate zone, and extending into India, Africa (to the Cape) and its outlying islands, Java, &c. Also in the Chatham Islands.

* Gr., *Ophios*, of a serpent; *glossa*, the tongue; from the fruiting spike.

Like the last, this species occurs in moist, grassy ground throughout both islands. I have followed the "Synopsis Filicum" in dividing our forms of *Ophioglossum* into two species; but most collectors have followed the arrangement in Hooker's "Handbook," where they are included under the one name of *A. vulgatum*, and hence it is not always easy to recognize which form is intended in the various localities from which it has been recorded.

In order to grow these ferns, care must be taken in lifting them to take up the whole sod enclosing them, so as not to disturb the roots. Cultivation, in the ordinary sense of the term, is a course they will not submit to.

GENUS II.—**BOTRYCHIUM**,* *Swartz.* (*Moonwort.*)
(Pl. IV. fig. 4.)

Stipes erect, solitary, bearing one pinnate or compound sterile frond, and one fertile frond with branched spikes arranged in a compound panicle. Capsules globose, sessile in two rows along the face of the spikes, separate from one another, bursting transversely.

1. B. ternatum, *Swartz.*

Stout, rarely slender, 3-18 in. high; stipes 1-2 in long, sterile frond 3-9 in. each way, deltoid, 3- or 4-pinnatifid, on a distinct petiole 2-4 in. long; lower pinnæ much the largest, and pinnules of the lower side larger than the others; ultimate segments oblong or obovate, obtuse or acute, slightly toothed. Fertile panicle 1-3 in. long, often much branched, very compound and deltoid, on a nearly radical peduncle, which is 3-9 in. long.

Synonyms.—B. Australe, *R. Br.*; B. virginianum, *Hook. f.*; B. cicutarium, *Swartz*; B. lunarioides, *Swartz*; Osmunda ternata, *Thunb.*

Var. *dissectum.*—Frond thin and slender, much divided; ultimate divisions acute and sharply incised.

Distribution.—The typical form is widely spread over extra-tropical North America, part of Europe, Asia, Australia, and Tasmania. Var. *dissectum* occurs in North America, as well as in New Zealand and the Chatham Islands. It is not common, however, with us, but has been recorded from various localities between North Cape and Otago. The typical form is common, occurring chiefly in damp, grassy ground, but exhibiting a wide range in its choice of soils and the elevation at which it grows. It also sometimes bears as many as two, or even three, sterile fronds.

If lifted with some of its accompanying sod, this fern soon establishes itself in the fernery. It is much more readily shifted about than *Ophioglossum*, and is an extremely hardy plant.

* Gr., *Botrys*, a bunch or cluster, from the fruiting panicle.

Order III.—MARSILEACEÆ.

(The characters of the Order are given at p. 17.)

Genus I.—PILULARIA,* *L.*

Rhizome filiform, creeping, rooting at the nodes. Barren fronds reduced to a filiform stipes, few or clustered at the nodes. Involucres globose, solitary at the nodes, sessile or shortly stalked. Sori 2-4, each enclosed in a membranous sac or covering, which apparently divides the involucre into 2 or 4 cells. In these cells are two kinds of spore cases, the lower ones, or macrosporangia, containing macrospores; the upper, or microsporangia, containing microspores.

1. P. novæ-zælandiæ, *Kirk.*

This hitherto uncommon little plant was described and figured by Mr. Kirk in the "Transactions of the N.Z. Institute," vol. ix. p. 547, and the following is his description, with the terms slightly altered:—

Rootstock creeping. Leaves (fronds) solitary, 1-2 inches long, erect, setaceous. Involucre globose, 2-valved, 2-celled, on an erect stalk ¼ in. long; microsporangia numerous, pyriform, each containing 20-30 microspores; macrosporangia 20-25, ovoid, macrospores globose or globose-ovoid, regular, not constricted.

Habitat.—Lakes Lyndon and Pearson, Canterbury district, at an elevation of 2,000-2,800 ft. Apparently also at Whangape Lake, Waikato, in the North Island.

In general appearance this plant might be taken for a very small creeping form of grass, but for its little globular involucres.

Order IV.—SALVINIEÆ.

(The characters of the Order are given at p. 18.)

Genus I.—AZOLLA, *L.*

Plant floating, forming small red patches, consisting of pinnate fronds, covered with minute imbricating leaves. Roots of simple solitary threads. Stem consisting of a central cellular axis, with a few spiral threads, surrounded by a circle of air-cells. Receptacles very minute, of two kinds, inserted at the base of the fronds; the larger sort female, ovoid, bursting irregularly, containing a number of ovoid-stalked capsules (or *sporangia*) each containing 1 or more

* Lat., *Pilula*, from the form of the little capsule.

spores; the smaller sort bursting transversely, containing rounded *antheridia*, produced on a central erect column.

The above description is mainly adapted from "Hooker's Handbook," which again had borrowed it from Prof. Gray's "Manual of the Botany of the North United States." The genus is imperfectly known, the only monograph on the subject being "Ueber Azolla," published by Prof. Strasburger, of Jena (in 1873), in which the affinities and structures are discussed, and four genera are described. There is no English translation of this work.

1. A. filiculoides, *Lam.*; var. rubra.

Fronds reddish, ovate-orbicular, or somewhat triangular, $\frac{1}{2}$-2 in. in diameter, pinnate; branches close-set, almost imbricating, somewhat palmate. Leaves densely imbricate, ovate, entire, obtuse, $\frac{1}{20}$ in. long, smooth on the upper surface. Roots longitudinally plumose beyond the middle.

Synonym.—A. rubra, *Br.*

Distribution.—Tasmania and Australia.

A very common plant in pools and ditches in most parts of New Zealand, forming a reddish mantle on the surface of the water. It is not only a beautiful little plant, but is a most interesting study under the microscope. In tanks or aquaria containing a sufficient supply of soil at the bottom of the water it may be grown very readily, but it requires a constant change of the water.

Order V.—LYCOPODIACEÆ.

(The characters of the Order are given at p. 18.)

Minute plant; leaves radical, linear, surrounding a leafless peduncle which bears at its apex a short spike formed of imbricating scales, each of which covers a solitary capsule	1. Phylloglossum.
Stems branching, with small leaves, usually crowded in 2 or 4 rows. Capsules solitary in the bracts of terminal spikes or the upper leaves of the stem	2. Lycopodium.
Stems leafy, simple; leaves rather large. Capsules 2-celled, solitary and sessile in the axils of the leaves	3. Tmesipteris.

Stems leafless, branched, 3-angled. Capsules 3-celled, lateral on the branches, usually in the axils of minute bifid bracts ... ... 4. Psilotum.

GENUS I.—PHYLLOGLOSSUM,* *Kunze.* (Pl. IV. fig. 5.)

A small stemless plant, with a rootstock bearing 2 ovoid tubers, and a few fibrous roots from the crown. Leaves and peduncles radical. Scape terminated by an ovoid spike of 3-gonous, imbricated scales. Capsules solitary in the axils of the scales, 1- or 2-celled, 2-valved, filled with minute powdery spores.

1. P. drummondii, *Kunze.*

Green and glabrous, 1-3 in. high. Leaves 6-10, linear, $\frac{1}{4}$-$\frac{1}{2}$ in. long. Peduncle usually about twice as long; scales broad, with an erect beak, pedicelled at the base.

Synonym.—Lycopodium sanguisorba, *Spring.*

Distribution.—Australia and Tasmania.

This curious little plant is very local in its occurrence, and is readily overlooked. In the North Island, it occurs—usually in open ground—from Auckland to the Bay of Islands; and is said to occur in Canterbury district by Mr. Armstrong.

GENUS II.—LYCOPODIUM,† *L.* (*Club-Mosses.*) (Pl. IV. fig. 6.)

Stems creeping, prostrate or erect. Leaves small, in 2 or 4 rows, or imbricating all round the stem. Capsules 1-celled, 2-valved, reniform, sessile in the axils of the upper leaves, or in the scales of terminal or lateral spikes. Spores minute and powdery.

The following key to the New Zealand species is chiefly adapted from Hooker's "Handbook to the N.Z. Flora":—

I.—*Leaves imbricating round the stem, usually* $\frac{1}{4}$-$\frac{1}{2}$ *in. long. Capsules in the axils of the upper leaves, or in the scales of sessile, terminal, tetragonal spikes.*

Stems 3-6 in. long, erect, growing in swamps. Leaves lanceolate, dark-green. Capsules axillary in the upper leaves ... ... 1. L. selago.

Stems 6-18 in. long, ascending or pendulous from trees, &c. Leaves linear-lanceolate. Spikes 1-3 in. long; bracts variable, usually much longer than the capsules ... ... 2. L. varium.

* Gr., *Phyllon*, a leaf; *glossa*, the tongue; from the shape of the leaves.
† Gr., *Lykos*, a wolf; *pous*, a foot; from some imaginary resemblance.

Stems 2-4 ft. long, pendulous from trees, &c. Leaves linear-oblong or -lanceolate. Spikes 2-6 in. long; bracts broad, shorter than the capsules ... 3. L. billardieri.

II.—*Leaves under* $\frac{1}{4}$ *in. long, imbricating all round the stem. Spikes cylindrical, sessile.*

a. Stems 1-3 ft. long. Spikes terminal.

Stems erect, densely branched. Spikes $\frac{1}{2}$-$\frac{3}{4}$ in. long, erect, with squarrose scales ... ... 4. L. densum.

Stems creeping, with spreading or flexuous branches. Spikes $\frac{1}{6}$-$\frac{1}{4}$ in. long, usually nodding, with toothed or ciliate scales 5. L. cernuum.

b. Stems 2-4 in. long. Spikes terminal.

Stems procumbent, densely branched. Spikes $\frac{1}{2}$-$\frac{3}{4}$ in. long, erect, with slightly-toothed scales ... ... 6. L. ramulosum.

c. Stems 3-10 in. long. Spikes lateral.

Stems branched from the base; branches slender, erect. Spikes $\frac{1}{4}$-$\frac{2}{3}$ in. long, erect; scales broad, with a short, acuminate apex ... ... 7. L. laterale.

III.—*Leaves under* $\frac{1}{4}$ *in. long, imbricating all round the stem. Spikes peduncled.*

Stems creeping, 2-6 in. long, with few branches. Spikes 1-2 in. long, on a stiff lateral peduncle, 1-4 in. long... 8. L. carolinianum.

Stems creeping, 4-10 in. long, with numerous dense branches. Spikes 1-3 in. long, on short, stout, terminal peduncles... ... ... 9. L. clavatum.

IV.—*Leaves in two opposite rows, with smaller adnate ones. Spikes cylindrical, terminal, and sessile.*

Stems creeping, 1-2 ft. long. Spikes solitary or in pairs... ... ... 10. L. scariosum.

Stems climbing, 2-10 ft. long. Spikes in branched panicles ... ... 11. L. volubile.

1. L. selago, *L.*

Stems 3-6 in. long, erect or slightly decumbent, and rooting at the base; stout, and usually forming dense, level-topped tufts. Leaves

densely imbricating, $\frac{1}{4}$-$\frac{1}{3}$ in. long, lanceolate, with a short sharp point, dark-green (reddish when dry), erect or spreading. Capsules in the axils of the upper leaves, which are similar to the stem-leaves, and not forming a spike.

Distribution.—Common in most arctic, antarctic, and cold mountainous regions of the globe.

In the N. Island of New Zealand this characteristically alpine club-moss has only been collected in one locality, viz., at Mutokino, by Mr. Kirk. In the South Island it is common in the mountain districts, at elevations between 1,500 and 6,000 ft.

2. L. varium, *Br.*

A very variable plant, intermediate between *L. selago* and *L. billardieri*, with which latter it is sometimes included as a variety. Stems 6-18 in. long, decumbent or erect, often pendulous from trees. Leaves crowded round the stem, linear-lanceolate, obtuse, spreading or erect, $\frac{1}{4}$-$\frac{1}{2}$ in. long, dark-green. Spikes 1-4 in. long, solitary or 2 or 3 together, terminal, 4-gonous, usually drooping; scales $\frac{1}{6}$-$\frac{1}{4}$ in. long, ovate, obtuse.

Synonym.—L. sulcinervium, *Spring.*

Distribution.—Australia, Tasmania (where it is abundant), and apparently in S. Africa and some of the Pacific Islands. Also occurring in the Chatham, Auckland, and Campbell Islands.

In the mountain districts of both Islands of New Zealand; common in Otago up to 6,000 ft. It is said to be rare in Canterbury, and has been recorded by Mr. Kirk from Kawau. It is often confused by collectors with the next species.

3. L. billardieri, *Spring.*

Stems 2-4 ft. long, usually pendulous from trees, flexuous, and much branched. Leaves $\frac{1}{4}$-$\frac{3}{4}$ in. long, linear-oblong or -lanceolate, obtuse or acute, imbricating all round, rather loosely below, densely above. Spikes 2-6 in. long, slender, 4-gonous, dichotomously branched; scales broadly ovate, obtuse, keeled, often shorter than the capsules, laxly imbricating.

Synonyms.—L. flagellaria, *A. Rich.*; L. phlegmaria, *A. Cunn.* (not of Linnæus, which is an Australian species).

Distribution.—Confined to New Zealand, where it ranges from the Bay of Islands to Stewart Island, ascending to 2,500 ft. at the Thames. It is common wherever there is bush land. According to Sir J. D. Hooker it "almost passes into various tropical forms, but is not exactly similar to any."

Owing to its tufted habit, this is one of the most easily cultivated species of the genus, and should be found in every fernery. It is very hardy, is easily transplanted, and in a damp, shady situation forms a very handsome plant. No doubt *L. varium* could be as

easily and satisfactorily cultivated, as its habit is almost exactly similar.

4. L. densum, *Labill.*

Rhizome short, stout, creeping. Stems 1-3 ft. high, rigid, erect, densely branched above; branches usually erect. Leaves imbricated all round the stem, the lowest $\frac{1}{8}$-$\frac{1}{6}$ in. long, those on the branches $\frac{1}{16}$-$\frac{1}{12}$ in., lanceolate, acuminate or scarious at the tips, appressed, spreading or squarrose. Spikes $\frac{1}{2}$-$\frac{3}{4}$ in. long, numerous, terminal, erect, and sessile; scales ovate-lanceolate or 3-angular, with spreading or squarrose, scarious tips.

Distribution.—Tasmania, Australia, Norfolk Island, and New Zealand. Also in Chatham Islands.

Common in the northern portion of the N. Island of New Zealand, from N. Cape to the Hot Lake district, and ascending to 2,500 feet at the Thames. There is said to be one locality in the South Island where it occurs, but I am not aware where it is. In its most robust forms this is the most tree-like species of the genus in this colony.

5. L. cernuum, *L.*

Stems stout, 2-3 ft. long, creeping and leafy, sending up numerous stiff, much-divided branches, 6-12 in. high. Leaves $\frac{1}{6}$ in. long, subulate, imbricated all round the stem, incurved or spreading. Spikes $\frac{1}{6}$-$\frac{1}{4}$ in. long, terminal, cylindric, sessile, nodding; scales ovate-lanceolate, with long tips, margins scarious, ciliate and serrulate above, usually imbricating in 8 rows.

Distribution.—A common species in all tropical and sub-tropical regions of the world, and often in favourable localities attaining an elevation of 5 or 6 ft.

With us its area is a restricted one, ranging from the Thames River northwards. It occurs in the greatest abundance in the Hot Lake district, luxuriating in the hot, steamy atmosphere of the boiling pools and springs.

6. L. ramulosum, *Kirk.*

"A procumbent plant, forming compact masses; stems 2-4 in. long, rather stout, repeatedly dichotomously branched; leaves crowded all round the stem, imbricated or spreading, $\frac{1}{5}$-$\frac{1}{4}$ in. long, narrow-subulate, coriaceous above, acute or pungent; spikes numerous, terminal $\frac{1}{2}$-$\frac{3}{4}$ in. long, bracts small, sessile, ovate, abruptly acuminate, slightly toothed."

Habitat.—Hokitika and Okarita (Westland).

This species is described and figured by Mr. Kirk in the "N.Z. Inst. Trans.," vol. xi. p. 456. I do not know it.

7. L. laterale, *Br.*

Stems prostrate, ascending or erect, 3-12 in. long, simple or branched; leaves $\frac{1}{6}$-$\frac{1}{3}$ in. long, lanceolate-subulate, imbricating all round the stem, spreading and squarrose; spikes lateral and sessile, about $\frac{1}{2}$ in. long, brown or yellowish; bracts small, in about 4 rows, broadly ovate, suddenly contracted to a stiff erect point.

Var. *diffusum*, *Br.*—Smaller and more rigid; branches numerous, ascending. Leaves about $\frac{1}{6}$ in. long; spikes brown.

Distribution.—Tasmania, Australia, and New Caledonia. Also found in the Chatham Islands.

A species of wide range in New Zealand, occurring in rather swampy ground from N. Cape to Stewart Island, but often very local. Var. *diffusum* is chiefly alpine in its occurrence, but also ranges from sea-level, in Stewart Island and other places, to a considerable elevation.

8. L. carolinianum, *L.*

Stems 2-6 in. long, creeping and rooting like rhizomes, as do the few branches. Leaves $\frac{1}{6}$-$\frac{1}{4}$ in. long, narrow lanceolate, curved, acuminate, crowded all round the stem. Spike 1-2 in. long, cylindric, on erect lateral branches (peduncled) 1-4 in. long, which are covered with small erect leaves; scales broadly-ovate below, with rigid, spreading points, and scarious, serrulate margins.

Distribution.—Common in tropical and sub-tropical regions of both Old and New Worlds.

Its range in New Zealand is confined to a small portion of the northern part of the Auckland district, between the Bay of Islands, Mongonui, and Hokianga.

9. L. clavatum, *L.*; var. magellanicum, *Hook. f.*

Stems stout, rigid, creeping, and leafless below, 4-10 in. long; branches 3-12 in. high, stout, erect, dense. Leaves $\frac{1}{6}$ in. long, linear or linear-lanceolate, acute, imbricating all round the stem, spreading, squarrose, or incurved. Spikes 1-3 in. long, solitary or in pairs, on short, stout, leafy terminal peduncles; scales closely imbricating, lanceolate, with long, acuminate, spreading points.

Synonyms.—L. magellanicum, *Swartz;* L. fastigiatum, *Br.;* L. pichinense, *Hook.;* L. diffusum, *Spring.* (not *Br.*)

Distribution.—The typical form of the species is an abundant plant in the northern, and parts of the southern, hemisphere; it is chiefly characterized by the hair-like tips and serrulate margins of the leaves.

The southern variety is common in Australia, Tasmania, South America, and the Antarctic Islands. Also found in the Auckland, Campbell, and Chatham Islands.

It is abundant in the mountain regions of both islands, but ranges

from sea-level in Stewart Island to 6,000 ft. in Otago. The most northern locality yet recorded in New Zealand is the high land lying to the north of L. Rotorua.

10. L. scariosum, *Forst.*

Stems 9 in. to 2 or 3 ft. long, prostrate or creeping, with numerous prostrate or erect, flattened branches, 2-10 in. long. Leaves of two kinds, the larger in two opposite rows, $\frac{1}{6}$-$\frac{1}{8}$ in. long, oblong or lanceolate, acute, falcate, laterally flattened and decurrent, with smaller, appressed, subulate leaves between. Spikes sessile or peduncled, usually terminal, solitary or in pairs, $\frac{1}{2}$-3 in. long; scales broad, with recurved spreading tips.

Synonyms.—L. decurrens, *Br.*; L. jussieui, *Desv.*; L. lessonianum, *A. Rich.*

Distribution.—Tasmania, Australia, mountains of South America and of Jamaica. Also in the Auckland and Chatham Islands.

Its range in New Zealand is extensive, from the north of Auckland to Stewart Island, usually in rocky or sandy ground, but it is local in occurrence. In the last-named locality it grows in swampy ground at sea-level, assuming a very stunted habit. It is common throughout the mountain regions of Otago from 1,500-6,000 ft. elevation; while at the Thames it occurs at about 2,000 ft.

11. L. volubile, *Forst.* (Pl. IV. fig. 6.)

Stems slender, wiry, much branched, 2-10 ft. long, or more, climbing over trees, branches, &c.; sparingly leafy. Leaves of two kinds, as in *L. scariosum*, but narrower, and with more acuminate—almost mucronate—tips. Spikes in branched dichotomous panicles, $\frac{1}{2}$-2 in. long, slender; scales broad, small, with a short, subulate, erect point.

Synonym.—L. d'urvillei, *A. Rich.*

Distribution.—Java, Sandwich Islands, and N. Australia. Also in the Chatham Islands.

This is one of the most common species in New Zealand, ranging throughout both islands, and in the N. Island ascending to 2,800 ft. on Tarawera. It is the most beautiful species of the genus, and is very extensively used for indoor decoration, particularly at festive seasons.

The cultivation of this, and in fact of most, species of Lycopodium will be found to be a matter of considerable difficulty, at least at the outset.

GENUS III.—TMESIPTERIS,* *Bernhardi.*

Stems simple, leafy, pendulous or ascending from a slender, creeping rootstock. Leaves vertical, sessile, decurrent, veinless.

* Gr., *Tmesis*, a cutting; *pteris*, the common name applied to ferns.

Capsules transversely oblong, 2-lobed, 2-celled, opening loculicidally by 2 valves, and placed in the fork of two leafy, shortly-petioled bracts. Spores minute. (A genus of only one species.)

1. T. forsteri, *Endlicher.*

Stems 6-24 in. long. Leaves ½-1 in. long, obliquely oblong, or narrow lanceolate, coriaceous, truncate, obtuse or acute, with a single nerve or midrib, which is often produced into a mucronate tip. Bracts similar to the leaves, but smaller, occasionally replacing them in the upper part of the stem. Capsules about ⅙ in. long.

Synonyms.—T. tannensis, *Bernh.*; T. truncata, *Desv.*; T. billardieri, *Endl.*; and many others.

Distribution.—Tasmania, Australia, and some of the Pacific Islands; also in Auckland and Chatham Islands. Its occurrence in California is also given in the "Handbook Flora N.Z.," but is apparently an error. The Australian specimens usually have the capsule broader than long, and very distinctly 2-lobed; in New Zealand specimens this last character is often nearly wanting. They are also very rarely 3-celled, showing an alliance with Psilotum.

With us this species is very common, being usually found as an epiphyte on trees. It ranges from N. Cape to Stewart Island, and ascends to 2,700 ft. at the Thames and on Pirongia.

Genus IV.—PSILOTUM,* *Swartz.*

Stems dichotomous above, leafless, or bearing minute scale-like leaves, which are occasionally replaced by minute 2-fid bracts. Capsules sessile in the axils of the bracts, nearly globular, 3-lobed, 3-celled, opening loculicidally in 3 valves. Spores minute.

1. P. triquetrum, *Swartz.* (Pl. IV. fig. 8.)

Rhizome short. Stems erect or pendulous, 3-15 in. long, simple below, repeatedly dichotomous above; branches 3-angled. Scale-like leaves and bracts scattered, ⅛ in. long. Capsules $\frac{1}{12}$-$\frac{1}{6}$ in. diam., attached to the bracts below the forks.

Distribution.—In most tropical or sub-tropical moist regions of both Old and New Worlds.

In New Zealand this peculiar-looking plant is confined to a small area of the N. Island; its southern limit being at Orakeikorako, in the Hot Lake district, and its eastern at Motuhora Island, in the Bay of Plenty. It is rather rare on the Auckland Isthmus, but abundant on the face of the volcanic rocks of Rangitoto.

* Gr., *Psilos*, naked, from its leafless appearance.

ORDER VI.—ISOËTEÆ.

(The characters of the Order are given at page 19.)

GENUS I.—ISOËTES,* *L.*

Aquatic plants, usually quite submerged. Leaves linear and thick or subulate, crowded on a short, thick rootstock, dilated and concave at the base. Sporangia (spore-cases) sessile at the base of the leaves, solitary, membranous, of two kinds; those of the outer leaves containing spherical macrospores, each marked with a transverse raised line, and above it 3 radiating raised lines; those of the inner leaves filled with minute powdery microspores.

Leaves 2-4 in. long, very slender, pale-green. Macrospores 6-angled; microspores obscurely 3-angular... ...	1. I. kirkii.
Leaves very numerous, stout, dark-green, 4-12 in. long. Macrospores globose; microspores ovoid	2. I. alpinus.

1. I. kirkii, *Braun.*

Rootstock 3-lobed. Leaves 10-20, 2-4 in. long, $\frac{1}{24}$ in. diam. at the middle, pale bright-green, nearly transparent, very slender, and tapering to the apex. Sporangium small, globose, 4-celled; macrospores small, 6-angled, beset all over with minute unequal tubercles.

This small species was first described by Mr. Kirk in New Zealand, and is figured in "N.Z. Inst. Trans.," vol. ii. p. 106. It appears to be very near *I. muelleri*, a Queensland species.

Distribution.—Confined to the North Island of New Zealand, occurring in lakes at a low level—viz., Lakes Whangape, Waikare, and Wahi, in the Lower Waikato district; and L. Rotokakahi, in Taupo district.

2. I. alpinus, *Kirk.*

Rootstock 3-lobed. Leaves 20-50, about 6 in. or more long, $\frac{1}{16}$-$\frac{1}{12}$ in. diam. at the middle, rather stout and rigid, dark-green, nearly transparent, base much dilated. Sporangium oblong $\frac{1}{6}$-$\frac{1}{5}$ in. long, 4-celled. Macrospores rather large, globose, perfectly smooth. Microspores ovoid, finely tubercled.

Distribution.—Confined to the South Island of New Zealand, in lakes at 2,000-3,000 ft. elevation—viz., Lakes Roto Iti, Rotorua, and Guyon, Nelson district; Lakes Lyndon, Pearson, Grassmere, and Windermere, in Canterbury district.

This species was described by Mr. Kirk in the "N.Z. Inst. Trans.," vol. vii. p. 377, and is fully figured at p. 368.

* Gr., *Isos*, and *etos*, evergreen.

CHAPTER IV.

HINTS ON COLLECTING AND CULTIVATING FERNS.

THE taste for gathering ferns is a very common one, but, like many others, it is none the worse occasionally of a little direction, and the experience of others will be of service to those about to make a commencement in this direction.

The apparatus required by the collector who is desirous of making a collection of dried ferns is very simple. It is well, however, to have it of the most suitable kind, so as to ensure the maximum amount of success. Some—when out in the field—take with them an old scrap-book, or boards filled with sheets of newspaper or some other slightly bibulous paper, but it will always be found better to have a special book made for the purpose. The majority of ferns are best pressed when gathered, though many of the more coriaceous kinds will keep well enough in a vasculum or japanned-tin collecting box.

A convenient book for placing the specimens in when collecting is made of thin wooden boards about 18 in. long by 12 in. broad, their thickness depending on the nature of the wood employed. Thus, English oak boards need not be more than $\frac{3}{8}$ in. thick, while common deal must be nearly $\frac{1}{2}$ in., and even of this thickness will be found to be as light as the other. The boards should be strengthened with cross-pieces fastened to them by short screws let in from the inside of the boards. Two leather straps passing through too narrow slits within an inch of the edge of each board serve to tighten them together, and these may be joined by a leather handle, or they may be so arranged as to fasten knapsack-fashion on the back. The best drying pads which can be used are made of a coarse bibulous paper, specially prepared for botanical purposes; but, in lieu of it, any blotting paper will suffice. The specimens to be gathered should be, of course, as perfect and complete as possible. Small species, which,

when full sized, do not exceed the size of the paper, should be gathered whole, their roots cleaned from soil and thinned down with the knife if necessary, on what is intended to be the underside of the specimen, and all unnecessary fronds removed. Larger species may be taken in two portions, while of the very large species usually only separate pinnæ can be dried. As, however, the stipes and its mode of attachment to the rhizome, and the rhizome itself, constitute important characters in classification, care should be taken to show these as far as possible. If the collector happen to be out without a book, but is furnished with a vasculum, he can usually bring his ferns home in very good order by laying them carefully in the box and sprinkling a little water over them. The air in the close space becomes saturated with aqueous vapour, and the fronds—even of delicate species—will be found to retain most of their freshness. Most of the genus *Hymenophyllum* and *Trichomanes* can even thus be carried for two or three days, but I have always failed with the *Todeas*. These should be pressed as soon as gathered, as their delicate segments curl up in the most aggravating manner, and afterwards refuse to be flattened.

As a rule, the pressure exercised by the straps will be found sufficient for the ferns while drying, but a few heavy books, or similarly weighty things, may be added if necessary. The plan adopted by some persons of putting their plants into a copying-press cannot be recommended; too much pressure destroys the beauty of some species.

Within about twenty-four hours of gathering, or as soon after as possible, the papers should be changed for fresh ones, and this process repeated again at intervals of every two or three days. The thinner ferns will be quite dry in ten days or a fortnight, while the more coriaceous forms may be aided by a hot pressing with a common iron between sheets of blotting paper. Some species—such as the varieties of *Asplenium obtusatum* and *Polypodium serpens*—require a long time and a considerable pressure to dry them thoroughly, and are all the better for an occasional hot press. The mode adopted by collectors, of killing many tough or succulent plants by plunging them in boiling water before drying, cannot be employed with ferns, as the sori are thus more or less destroyed.

In mounting the dried specimens, it is a mistake to put them in a ready-bound book, as it becomes almost impossible to arrange them satisfactorily. Good stiff white paper of about the same size as the drying sheets should be employed, and not more than a single species be fastened to each sheet. Many adhesive substances are used to attach plants to paper, of which some are good, while others are decidedly bad. To the latter class belong gum-arabic, the common mucilage of the shops, and flour paste. Specimens fastened by the first are very apt to start from the paper, the second has often very little adhesive power, while the third forms a direct inducement to mites to establish themselves on the collection. A fair gum may be made, however, by adding a few fragments of gum tragacanth to the ordinary mucilage. But the best substance which can be employed is a strong jelly made of gelatine, or—as a cheaper and equally effective substitute—Russian or gelatine glue. This is made by soaking the glue in a little water, and standing it in a warm corner for a few hours; the jelly thus formed is ready for use at any time by simply placing the vessel containing it in a bowl of boiling water. If wanted to be kept, a few drops of creosote or oil of cloves should be added while it is liquid. Strong jelly so made will keep in summer for two or three weeks, and much longer in winter, if sufficient creosote be added; but if decay has set in, or any mould commences to grow, the whole should be rejected at once, as its adhesive powers will be found to be seriously affected. Too much of the glue should not be applied to the side of the specimen which is to be downwards, as it is a great blemish to have your ferns all smudged and shiny. The stronger the glue, the less will be required to fasten the specimens. Long straggling stipes and other loose parts should be fastened down with thin strips of tough paper, foreign note being about the best. Each specimen should have its name clearly written on the sheet, together with locality and date of gathering, and any remarks on the habitat which may be considered worthy of note. The sheets should be placed together in a suitable portfolio, or in a specially-constructed herbarium case.

For a hundred persons in the colony who make collections of dried ferns, it would probably be difficult to find one who goes in for cultivation of the living plants. The taste has not sprung up yet,

but it is one which can be very easily gratified, and at a very little expense into the bargain. With a little practice ferns can be grown as easily as other plants, and some species will thrive in most unpromising situations. Considering how much labour and money are often expended in ornamenting our gardens, and in growing showy and expensive exotics in our greenhouses, it is somewhat surprising that the cultivation of ferns has not received more attention than has hitherto been the case. The appliances required —even for their indoor culture—are not very elaborate, while out of doors they are as easily grown as other plants, if a little consideration is previously given to their mode and place of growth in a state of nature. There are certain points which particularly call for attention in dealing with these plants. Thus, many of them are to be found only in the shade and moisture of the deepest parts of the forest, and these must have a house of some kind to protect them; while others, which grow on the bare hill-sides, and among clefts of dry rocks, refuse to grow altogether if put under cover, or else become sickly and straggling in their growth. Again, many ferns which will grow in the Auckland district in the open air cannot stand the sharp frosts of the level parts of Canterbury and Otago, and must have winter protection. To start with, then, it is necessary—if a tolerably complete collection is desired—to have the means of growing the plants under at least two different sets of conditions—viz., in an open air fernery and in a house of some kind.

An open-air fernery may be made in any spot sheltered by a wall or building, or in any naturally irregular spot of garden ground, where but little direct sunlight can penetrate, and where the force of the wind is not felt. A rugged, uneven surface suits ferns best; so that it has become a very usual practice to grow them in rockeries. It requires considerable artistic skill to build a rockery in such a way as to make it look natural; but in whatever manner it may be constructed, the principal advantage gained by adopting this plan lies in the excellent drainage which can be ensured under it. There is nothing that ferns are more liable to be destroyed by than stagnant water at their roots; and one of the first requisites, in preparing ground for growing them in, is to see that it is well drained, so that surplus water may pass quickly away from it. If a rockery is to be

constructed, it matters little what sort of stone or other material is used, so long as it is of a porous nature; and the taste of the cultivator must decide what form it is to assume. An excellent way of growing ferns is to make a raised bed, from 1 to 2 feet high, of porous stone, broken bricks, or similar materials, filling in the interstices with smaller fragments, and covering the whole with a few inches of soil, which should not, however, exceed six inches in depth for the smaller species, or a foot for the larger. A layer of *sphagnum* moss above the stones aids materially in draining, and prevents the soil from being washed rapidly down among the stones. If peat can be readily obtained, a quantity of it may be broken into small pieces, and similarly used for filling up the interstices of the stones, before spreading the soil on the surface. Such a bed, placed on the south side of a wall or building of almost any kind, will prove very suitable for all the hardy ferns. Next in importance to the drainage is the kind of soil employed. This should be light, and yet capable of being made quite firm. It is needless to give absolute rules for the preparation of such a soil, and nearly each successful cultivator has his own favourite compost; but a mixture of equal parts of well-broken peat, loam, and sand will be found most generally suitable. Manure of any kind should not be used; but an excellent loam may be got by allowing old turf from a meadow to decay for a couple of years in a heap. The sand, also, should not be too sharp; sea-sand, thoroughly washed free from salt, is very good. But here, again, observation of the natural habitat of the fern must guide the cultivator. Some of the *Gleichenias* will be found to luxuriate in a mixture of sand and peat, or even sand alone; while many of the larger bush-ferns grow in deep, heavy loam. Species of *Pteris*, again, often root strongly in clay banks with a minimum of loam. So that in planting the various kinds, more or less of the constituent parts may be added to the soil, as is thought desirable. Where manageable, it is a good plan to have the soil for a fernery baked before using, by subjecting it, in a moist state, to a heat about that of boiling water. This process destroys vast numbers of fungus spores and seeds of weeds, at the same time freeing the ground of insect pests. This should always be done with soil to be used in a house, but for the outdoor fernery it is not so

necessary; and it is, besides, a difficult thing to do with the quantity of soil required.

In planting your ferns, due regard must be had to the size to which each species grows, so that each may be placed in the position most suitable to it, and unnecessary crowding be avoided. In course of time, some of the species may have spread so much, either by their creeping rhizomes or by their scattered spores, as to endanger the existence of less aggressive species. By the time this desirable consummation has been reached, the cultivator will probably be sufficiently experienced in fern-growing to require no advice in dealing with his plants. But, in first planting, if species are being dealt with which have an erect rootstock, and which root in the soil to some depth, the only care requisite is to avoid burying the crown. Over-deep planting is usually an effective mode of extinguishing ferns. For those creeping species which are usually epiphytal in their growth, planting—in the ordinary sense of the word—is not advisable; but the rhizome should be pegged down on the soil, which must be kept somewhat moist till their roots have struck.

In dry weather it may be necessary to supply water to your ferns. This should be given in the morning, and applied to the soil only, not wetting the leaves more than you can help. It is a mistake to water any plants in the evening, as the rapid evaporation which takes place if the sky is clear reduces the temperature of the surface-soil and of the lower strata of air very materially.

For indoor cultivation, an ordinary lean-to greenhouse placed against the south wall of a house is most suitable; but as everyone does not and cannot possess such a convenience, it is advisable to show how an effective and inexpensive fern-house may be constructed. One of the best collections of New Zealand ferns under cultivation which the writer has seen was contained in a plain little house made by the cultivator—who was no mechanic—and which cannot have cost more than £1 or £2 in its construction. This consisted of a small lean-to shed, about 5 ft. high in front and 8 ft. at the wall, the frame of which was covered with weather-boarding. The roof was formed of three or four old window-sashes, while the upper half of the door was also glazed. Along the floor on the lower side of

the house was a narrow border, in which many small ferns were planted, while above them, at a height of about 3 feet, was a single shelf with a row of potted ferns. The ground on the side of the house next the wall was occupied by a larger bed, in which were arranged a number of taller species, some handsome sub-arboreous forms being furthest back. When the weather was frosty, old sacks or pieces of matting were thrown over the roof, but no artificial heat was employed. In this simply-constructed little house a large number of delicate ferns, including species of *Hymenophyllum*, *Trichomanes* and *Todea*, *Gleichenia dichotoma*, *Lomaria nigra*, *Marattia fraxinea*, and others, were growing in a most luxurious manner. Of course, there is but little of external ornamentation in such a house, yet how many a back-yard in some of the more crowded parts of our towns might thus be utilized and made to contribute to our pleasure as well as to our convenience.

Ferns are very easily grown as pot plants, and a stand of a few pots of well-grown Maiden-hairs and other hardy ferns makes an elegant addition to a sitting-room. While, instead of the tawdry wax or cloth flowers one sometimes sees in a drawing-room, there is nothing more beautiful than a good patch of *Hymenophyllum pulcherrimum*, or *Trichomanes reniforme*, growing in a pot or vase under a glass shade. In potting ferns, too great depth should be avoided, and the bottom should have a few "crocks," or broken materials, covered with a few fragments of peat for drainage. Creeping ferns, such as some *Adiantums* and *Gleichenias*, grow best in shallow pots which are wider than they are deep.

Club mosses are not very often cultivated, owing to the difficulty of getting them to grow; but some species may be grown along with ferns. The beautiful *Lycopodium volubile* and other creeping species are easily enough propagated by layering. Thus, if a shallow pot be placed on the ground alongside one of these plants, and a good branch be pegged down to the soil, roots will be developed at the point of contact; and when these are well established, the connection with the parent plant is severed by a sharp knife. All ferns, also, with creeping rhizomes may be similarly propagated. *Isoëtes*, *Pilularia* and *Azolla* require for their growth an aquarium jar or artificial pond,

at the bottom of which there is a layer of soil or mud. There is not the least difficulty in cultivating them, but care must be taken that confervoid algæ do not accumulate to any large extent; in which case the water must be changed, and small aquatic mollusca introduced. An aquarium must not be subjected to direct sunlight, as the rapid changes of temperature thus induced will soon prove fatal to the most valued specimens. It is best kept in the shelter of the fern-house, to the atmosphere of which its constant evaporation will always supply a sufficiency of moisture.

These hints as to culture are necessarily far from being complete, but they may lead readers to see the possibilities of interest and amusement which may be derived from this class of plants. For more complete information on the subject, the reader is recommended to peruse one of the larger works specially devoted to it, Shirley Hibberd's interesting little book, "The Fern Garden," being one of the best.

In making a collection of ferns for planting, always first satisfy yourself as to what species grow in your own neighbourhood, before bothering your friends a hundred miles away to get you plants. People often thus get specimens sent to them which are to be found within a short distance of their own homes. In lifting ferns the roots should be carefully dug up, not wrenched; and in most cases as big a ball of soil should be taken with them as can be conveniently lifted. Thus species of *Lindsaya*, *Botrychium*, *Ophioglossum*, and even some *Gleichenias* will not grow unless the whole plants are lifted intact and with the roots quite undisturbed. But many other species will stand very hard usage as compared with this, though all are the better of careful handling. They are best transported with their fronds uncrushed in a box or basket; and, in the case of *Hymenophyllums* and similarly delicate forms, the botanical vasculum with tightly-fitting lid will be found most useful. But if it is desired to carry plants for a long distance—say from this colony to Australia—another plan must be adopted. Each specimen, with its ball of somewhat moist but not wet earth, should be wrapped up in damp moss, and the whole tied up in paper or thin sacking. All the fronds but four or five should be removed, and these should be allowed to protrude from their wrappings. The packages thus made

can be placed together in a box, with all their fronds lying one way; and if kept covered, for protection from sun and drying winds, the ferns may thus be carried with perfect safety for some weeks. They must be planted as soon as possible on arrival at their destination, and the cultivator must not be disappointed if they do not begin to make growth till the commencement of a new season.

GLOSSARY OF TECHNICAL TERMS.

A, privative, signifying the absence of the organ mentioned.
Acerose, needle-shaped.
Acicular, bristle-shaped or thinly needle-shaped.
Acuminate, ending in a finely tapering point.
Acute, terminating in a sharp point.
Adnate, applied to an organ united to another throughout its length.
Amplexicaul, clasping or embracing the stem.
Anastomosing, the uniting of veinlets in the leaf of a plant.
Antheridia, the minute male organs of Cryptogamic plants.
Apiculate, ending in a short pointed tip.
Appressed, lying flat against a surface, as leaves on a stem.
Arborescent, tree-like.
Areoles, spaces marked out on a surface, as by the reticulation of the veins.
Articulated, jointed; the *articulations* being either the portions joined, or the place of joining.
Ascending, applied to stems which rise in a slanting direction.
Auricled, or *Auriculate*, furnished with an ear-like appendage.
Axil, the angle formed between a leaf and the stem.
Axillary, anything placed in an axil.
Bifid or 2-fid, two-cleft to about the middle.
Bilocular or 2-locular, containing 2 cavities or cells.
Bipinnate or 2-pinnate, doubly or twice pinnate; similarly, *bipinnatifid*, &c.
Bract, a more or less modified leaf from the axil of which flowers or other reproductive organs proceed.
Campanulate, bell-shaped.
Capillary, very slender and hairlike.
Capsule, a dry seed-vessel, applied to the spore-cases of Ferns and their allies.
Caudex, the trunk of a tree-fern.
Cell, applied to the cavity of a seed-vessel or spore-case.
Cilia, thin hairs fringing the margin of a leaf, &c., hence *ciliate*.
Circinate, rolled inwards from the summit towards the base, as in the young fronds of ferns.
Connate, applied to the uniting together of two or more similar parts.
Cordate, heart-shaped.
Coriaceous, leathery in consistence.
Costa, the midrib.
Crenate, having rounded teeth on the margin.
Cuneate, wedge-shaped.
Cuspidate, tapering to a sharp, rigid point.
Deciduous, applied to parts which fall off.
Decompound, applied to leaves cut into numerous divisions.
Decumbent, lying flat, but with the summit ascending.
Decurrent, applied to leaves whose blade is continued down the stem in the form of a wing.
Deflexed, bent downwards.
Dehisce, to open so as to scatter the seeds or spores.
Deltoid, triangular, like the Greek letter Δ (delta).

Dentate, toothed; usually applied to sharp teeth not directed forwards.
Dichotomous, having the divisions of the stem always branching in pairs.
Didymous, twin; found in pairs.
Digitate, spreading like the fingers.
Dimidiate, applied to organs split into unequal halves.
Dimorphic, having two forms.
Distichous, arranged in two rows on opposite sides of a stem.
Divaricate, applied to branches which spread very widely.
Dorsal, relating to or attached to the back.
Elliptical, shaped like an ellipse; oval or oblong with regularly rounded ends.
Emarginate, notched at the apex.
Entire, applied to margins which are not cut into in any way.
Epiphyte, a plant which grows upon another without taking any nutriment from it.
Equilateral, equal-sided.
Erect, standing straight up; often applied to leaves which are perpendicular to the surface of attachment.
Exserted, protruding beyond or out of.
Falcate, bent, or shaped like a sickle.
Fid, cleft or lobed.
Filiform, thread-like.
Fimbriate, fringed.
Flabellate, expanded like a fan.
Flaccid, limp, soft and weak.
Flexuous, curved in a zigzag manner.
Foliaceous, having the form or texture of a leaf.
Glabrous, quite destitute of hairs.
Glandular, applied to hairs which have glands on their tips.
Glaucous, covered with a pale bloom.
Globose, round like a ball.
Gonous, angled, as 3-gonous.
Heterosporous, applied to Cryptogamic plants having more than one kind of spore, as in *Isoëtes*.
Hirsute, covered with stiff or coarse hairs.
Hispid, covered with rigid or bristly hairs.
Hispidulous, minutely hispid.
Imbricate, overlapping, like tiles on a house.
Incised, cut sharply and irregularly.
Indusium, the covering of the sorus of a fern, called here an *involucre*.
Involucre, the membrane covering the sorus.
Involute, rolled inwards; applied to the margins of leaves when rolled in towards the middle.
Isosporous, applied to Cryptogamic plants which produce only one kind of spore, as ferns.
Lacerate, apply to margins which appear irregularly torn.
Laciniate, cut into very narrow strips or segments.
Lamina, the blade or expanded portion of a leaf.
Lanceolate, having the form of a lance-head; narrower than oblong, and tapering to each end.
Lateral, belonging to or borne on the sides.
Ligulate, shaped like a strap.
Linear, narrow or line-like; applied to very narrow leaves many times longer than broad.
Lobe, applied to the divisions of leaves or other organs.
Locular, divided into cells or loculi.
Loculicidal, the mode of opening of a capsule when the walls of the loculi fall out, carrying the septa with them.
Lunate, half-moon shaped.
Lyrate, applied to pinnatifid leaves with a large terminal and smaller lateral lobes.
Macrospores, the larger kind of spores in Lycopodiaceæ.
Macrosporangia, the vessel or capsule containing the macrospores.
Membranous or *Membranaceous*, thin and rather soft or pliable in consistence.
Microspores, the smaller spores of Lycopodiaceæ, hence *Microsporangia*.
Mucronate, ending in a sharp, short spine.

Muricate, rough, with short, hard points.
Node or Knot; the part of a stem at which a leaf is given off.
Normal, agreeing with the usual rule or type.
Ob, reversed, prefixed to many words as below.
Obcordate, like an inverted heart with the notch at the apex.
Oblique, unequal-sided or slanting.
Obovate, shaped like an egg with the broad end up.
Obtuse, blunt or rounded at the extremity.
Orbicular, completely circular in outline.
Ovate, shaped like an egg, broad end down.
Ovoid, applied to an egg-shaped solid.
Paleaceous, of a chaffy nature.
Palmate, divided into finger-like lobes.
Panicle, a much-branched cluster—usually applied to flowers, or to the spikes of some Lycopods.
Partite, cleft nearly but not quite to the base.
Patent, spreading widely.
Pectinate, comb-like, applied to pinnatifid leaves with narrow, close-set segments.
Pedate, divided like the feet of a bird.
Pedicel, a small, secondary fruit or flower-stalk, hence *pedicelled.*
Peduncle, a primary fruit or flower-stalk, hence *pedunculate.*
Pellucid, semi-transparent, allowing light to pass through.
Peltate, shield-like, attached by the middle of the lower surface.
Pendulous, hanging downwards.
Pilose, covered with soft, distinct hairs.
Pinna, one of the primary divisions of a pinnate leaf.
Pinnate, applied to leaves whose leaflets are arranged along each side of a common rachis.
Pinnatifid, cut into lateral segments midway to the midrib.
Pinnatipartite, cut into lateral segments nearly to the midrib.
Pinnatisect, cut quite to the rachis.
Pinnule, one of the secondary divisions of a pinnate leaf.
Plumose, feathery.
Procumbent, applied to stems lying along the ground.
Proliferous, bearing buds or bulbils on the leaves, &c.
Prothallus, the rudimentary plant proceeding from the germination of the spore in ferns, &c.
Pubescent, covered with soft, downy hairs.
Punctate, having the surface dotted with small holes or pits.
Pungent, ending in a sharp point.
Pyriform, shaped like a pear.
Radical, usually applied to leaves, &c., proceeding from a root-like portion of the stem.
Ramification, branching.
Rachis, the continuation of the stalk or stipes on which the pinnæ of a pinnate leaf are arranged.
Reniform, kidney-shaped.
Reticulated, having the veins in the form of network.
Revolute, rolled back at the margins.
Rhizome, a root-like stem running either above or below the ground, usually sending down roots below and leaves or branches above.
Rhomboid, having four sides all equal, but the angles not right angles.
Rootstock, the rhizome.
Sarmentum, the slender woody stem of climbing plants, hence *sarmentose.*
Scabrous or *Scabrid*, rough to the touch.
Scalariform, ladder-like; applied to the transversely-marked tissue of ferns, &c.
Scandent, climbing.
Scape, a peduncle springing from the ground.
Scarious, thin, dry, and membranous, not green.
Segment, one of the divisions of a cleft organ, such as a leaf.
Septum, a division, usually applied to that which divides a capsule into cells or loculi.
Serrate, with the margin cut into saw-like teeth.

Sessile, applied to any organ destitute of a stalk.
Setaceous, bristle-like.
Setose, covered with minute bristles or setæ.
Sinuate, with a strongly wavy margin.
Sinus, a hollow between the lobes of a leaf.
Sorus, a cluster of spore-cases or sporangia.
Spores, the minute grains in flowerless plants analogous to the seeds of flowering-plants.
Sporangia, spore-cases.
Squamose, covered with scales.
Squarrose, having scales, &c., projecting widely from the stem on which they are crowded.
Stellate, star-shaped.
Sterile, incapable of producing seed or spores.
Stipes, the stalk of a fern-frond.
Stipitate, furnished with a stipes or stalk.
Stipules, leaf-like appendages, usually paired, at the base of a leaf-stalk.
Stramineous, straw-like.
Striate, marked with fine longitudinal lines or streaks.
Sub-, used in composition, denotes somewhat or slightly, as subacute.
Subulate, awl-shaped.
Synonym, a superseded or unused name.
Terete, having the transverse section cylindrical.
Tetra-, in Greek words, four, as *tetragonous*, 4-angled.
Tomentum, a matting of dense, woolly hairs.
Tortuous, bent in different directions.
Transverse, across.
Tri-, in compound words, three, as *triquetrous*, with 3 salient angles.
Tripinnate, divided three times in a pinnate manner.
Truncate, cut off abruptly.
Tubercled, covered with small warty outgrowths.
Tumid, swollen.
Unilateral, one-sided.
Unilocular, a one-celled cavity.
Urceolate, shaped like an urn, with a narrow mouth.
Venation, the arrangement of the veins in the leaf.
Vernation, the arrangement of the leaves in the leaf-bud.
Villous, covered with long weak hairs or down.

GLOSSARY OF SPECIFIC NAMES OF PLANTS.

aculeatum, prickly or thorny.
æthiopicum, belonging to Ethiopia (upper Nile region).
affine, connected with, or related to.
alpina, belonging to the Alps.
aquilina, like an eagle.
articulatum, jointed.
banksii, in honour of Sir Joseph Banks, botanist in Cook's first expedition.
barbara, strange or foreign.
bifida, divided into two portions.
billardieri, in honour of La Billardiere, author of a beautiful work on the botany of New Holland.
bivalve, two-valved.
bulbiferum, bearing little buds or bulbils.
capense, belonging to the Cape (of Good Hope).
carolinianum, first described from Carolina, in America.
caudata, tailed, ending in a long, slender point.
cernuum, with the face towards the earth.
cheesemanii, in honour of Mr. T. F. Cheeseman, of Auckland, who has added largely to our knowledge of New Zealand botany.
ciliatum, fringed with hairs, like eyelashes.
circinata, rolled up like a crozier, from the apex in towards the base.
clavatum, club-shaped or club-bearing.
colensoi, in honour of Mr. W. Colenso, of Hawke Bay, one of the most indefatigable of New Zealand botanists.
comans, hairy, covered with hairs.
connexa, connected, joined.
cordifolia, with heart-shaped leaves.
cunninghamii, in honour of Allan Cunningham, an eminent Australian botanist and explorer.
cystostegia, bladder-roofed, from the bladder-like involucres.
dealbata, white or white-washed.
decompositum, very much divided.
demissum, low-lying or drooping, in allusion to the habit.
densum, close, crowded or thick-set.
diaphanum, allowing light to pass through.
dicarpa, two-fruited.
dichotoma, having the stem branching in pairs.
dilatatum, enlarged, the segments being wide and dilated.
discolor, two-coloured, the back and front of the frond being different.
distans, distant, the pinna being widely separated on the rachis.
drummondii, in honour of Mr. Jas. Drummond, an Australian collector.
dura, hard; the texture of the fronds being very firm.
falcata, curved, like a reaping-hook.
filiculoides, fern-like.
filiformis, thread-like, very slender.
fistulosa, pipe-like; the usual meaning of the term is porous or full of holes.
flabellata, *flabellifolium*, fan-like; applied to leaves or the branching of veins, &c.
fluviatilis, belonging to, or growing near, a river.
formosum, beautiful or finely formed.

forsteri, in honour of R. and G. Forster (father and son), botanists in Captain Cook's second voyage to New Zealand.
fragilis, tender or delicate.
fraxinea, like the ash-tree.
frazeri, in honour of Mr. Charles Frazer, a former superintendent of Sydney Botanical Gardens, who introduced some New Zealand plants into Britain.
fulvum, deep or reddish yellow.
glabellum, destitute of hairs.
grammitidis, resembling ferns of the genus *Grammitis*, Swartz.
hispidulum, *hispidum*, hairy, the first term being a diminutive of the second.
hookerianum, in honour of Sir W. Hooker, the celebrated botanist, whose son, Sir J. D. Hooker, wrote the "Flora Novæ-Zælandiæ," &c.
humile, low, small or humble.
hymenophylloides, like the thin, filmy ferns of the genus *Hymenophyllum*, Sm.
incisa, cut deeply into.
javanicum, first introduced into Britain from Java.
kirkii, in honour of Mr. Thos. Kirk, F.L.S., who has contributed so much to our knowledge of New Zealand botany for over ten years.
lanata, furnished with woolly hairs.
lanceolatus, lance-shaped; narrowly oblong and tapering to both ends.
laterale, belonging to, or springing from, the side (of a branch or stem).
leptophylla, thin-leaved.
linearis, narrow or line-like.
lusitanicum, belonging to, or first described from, Lusitania, the old name for Portugal.
lyallii, in honour of Dr. Lyall, botanist on board the *Acheron*, which visited New Zealand in 1847–49.
macilenta, lean or meagre.
malingii, in honour of a Mr. Maling, who collected ferns, &c., in New Zealand.
media, middle, intermediate between others.
medullaris, containing marrow, in allusion to the mucilaginous pith.
membranacea, membranous, or thin in texture.
millefolium, thousand-leaved; very much cut into and divided.
minimum, very small.
molle, soft, or covered with soft hairs.
montanum, belonging to the mountains.
multifidum, many times cut or divided.
nigra, black.
obtusatum, obtuse, blunt, or rounded at the ends.
oculatum, furnished with eyes or eye-like spots.
patersoni, in honour of D. Paterson, an Australian explorer and collector.
pennigerum, feathered or winged.
polyanthos, many-flowered; alluding to the numerous sori.
procera, high or tall.
pulcherrimum, very beautiful.
pumila, dwarf, or little.
punctatum, having small holes or punctures.
pustulatum, pimpled, covered with small elevations.
ramulosum, having many small branches.
rarum, rare.
reniforme, kidney-shaped.
richardi, in honour of Mons. M. A. Richard, author of "Essai d'une Flore de la Nouvelle-Zélande" (1832).
rigidum, rigid or firm.
rotundifolia, round-leaved.
rubra, red.
scaberula, *scabrum*, rough, covered with small roughnesses.
scariosum, having a dry, scaly consistence.
selago, the name of a genus of pretty S. African plants.
serpens, a serpent, in allusion to the twisted rhizome.
sieberi, in honour of the celebrated German botanist and traveller, Sieber.
smithii, in honour of Mr. J. Smith, the celebrated writer on Ferns; also of Sir J. E. Smith, first president of the Linnæan Society.

squarrosa, covered with projecting parts or jags, &c.
strictum, drawn together, tight or close.
subtilissimum, very finely woven, or very slender.
superba, superb, magnificent.
tenellum, somewhat tender or delicate.
tenuifolium, thin- or slender-leaved.
ternatum, divided into threes.
thelypteris, female fern, an old name used by Dioscorides.
tremula, tremulous or quaking.
trichomanoides, like the ferns of the genus *Trichomanes*.
triquetrum, having three sharp angles; applied usually to stems.
tunbridgense, from Tunbridge (Kent) in England.
umbrosum, shady or umbrageous, or growing in shade.
unitum, united.
varium, variable.
velutinum, velvety.
venosum, full of veins.
vestitum, clothed (with scales, &c.)
villosum, rough, hairy or shaggy.
viridis, green.
volubile, turning round or twining.
vulcanica, probably described first from some volcanic district.
vulgatum, common.

INDEX OF GENERA, SPECIES, &c.

(The Synonyms are printed in *italics*).

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PLATES.

PLATE I.

Fig. 1. *Gleichenia flabellata*, segment of frond (nat. size); *a*, portion of same showing sorus (mag.); *b*, portion of frond of *G. circinata* (nat. size).

Fig. 2. *Cyathea dealbata*, pinnule (nat. size); *a*, portion of same (mag.); *b*, empty involucre (mag.)

Fig. 3. *Hemitelia smithii*, pinnule (nat. size); *a*, portion of same (mag.); *b*, empty involucre (mag.)

Fig. 4. *Alsophila colensoi*, pinnule (nat. size); *a*, capsule (mag.)

Fig. 5. *Dicksonia antarctica*, segment of pinnule (mag.); *a*, sorus and involucre (much mag.)

Fig. 6. *Loxsoma cunninghamii*, portion of frond (nat. size); *a*, sorus and involucre (mag.)

Fig. 7. *Hymenophyllum pulcherrimum*, apex of frond (nat. size); *a*, fragment of same (mag.); *b*, involucre with one valve removed (mag.)

Fig. 8. *Trichomanes venosum*, frond (nat. size); *a*, sorus and involucre (mag.)

Fig. 9. *Davallia novæ-zælandiæ*, apex of frond (nat. size); *a*, portion of pinnule (mag.)

PLATE II.

Fig. 1. *Cystopteris fragilis*, portion of frond; *a*, sorus with involucre turned back; *b*, involucre in position covering the sorus (all mag.)

Fig. 2. *Lindsaya viridis*, portion of frond (nat. size); *a*, *L. linearis*, portion of frond (nat. size); *b*, segment of same, showing sori with the involucre turned back (mag.)

Fig. 3. *Adiantum æthiopicum*, portion of frond (nat. size); *a*, involucre turned back, showing the sorus placed upon it (mag.)

Fig. 4. *Hypolepis millefolium*, portion of frond (nat. size); *a*, *H. distans*, pinnule (mag.)

Fig. 5. *Cheilanthes tenuifolia*, pinna (mag.); *a*, sorus with the marginal involucre turned back (much mag.)

Fig. 6. *Pellæa rotundifolia*, portion of frond (nat. size); pinna (mag.)

Fig. 7. *Pteris macilenta*, pinnule (nat. size); *a*, *P. incisa*, pinnule (nat. size).

Fig. 8. *Lomaria banksii*, portion of sterile frond (nat. size); *a*, portion of fertile frond (nat. size); *b*, back of same (mag.)

Fig. 9. *Doodia media*, pinnæ (nat. size); *a*, portion of same (mag.)

PLATE III.

Fig. 1. *Asplenium flabellifolium*, portion of frond (nat. size).

Fig. 2. *Asplenium flaccidum*, portion of frond (mag.)

Fig. 3. *Aspidium capense*, portion of frond (nat. size); *a*, sorus covered with shield-like involucre (mag.)

Fig. 4. *Nephrodium velutinum*, portion of frond (slightly mag.); *a*, *N. hispidum*, portion of frond (nat. size); *b*, segment of same (mag.)

Fig. 5. *Nephrolepis cordifolia*, fertile pinna (slightly mag.); *a*, sorus (mag.)

Fig. 6. *Polypodium pennigerum*, pinna (nat. size).

Fig. 7. *Polypodium billardieri*, apex of frond (nat. size).

Fig. 8. *Notochlæna distans*, apex of frond (nat. size); *a*, pinnules showing sori (much mag.)

Fig. 9. *Gymnogramme leptophylla*, portion of frond (mag.); *a*, *G. pozoi*, portion of frond (nat. size).

Fig. 10. *Todea barbara*, pinnules (nat. size); *a*, portion of same (mag.); *b*, capsule (much mag.)

Fig. 11. *Schizæa dichotoma*, apex of frond (nat. size); *a*, *S. fistulosa*, apex of fertile frond (mag.)

PLATE IV.

Fig. 1. *Lygodium articulatum*, portion of fertile frond (nat. size); *a*, pinnule (mag.)

Fig. 2. *Marattia fraxinea*, portion of pinna (nat. size); *a*, one of the receptacles open (mag.)

Fig. 3. *Ophioglossum vulgatum*, frond (nat. size); *a*, capsules (mag.)

Fig. 4. *Botrychium ternatum*, fertile and sterile fronds (reduced); *a*, portion of fertile frond (mag.)

Fig. 5. *Phylloglossum drummondii* (nat. size); *a*, spike (mag.)

Fig. 6. *Lycopodium volubile*, fertile and sterile branches (nat. size); *a*, spore (much mag.)

Fig. 7. *Tmesipteris forsteri*, portion of frond (nat. size); capsule after opening (mag.)

Fig. 8. *Psilotum triquetrum*, portion of frond (nat. size); *a*, capsules (mag.)

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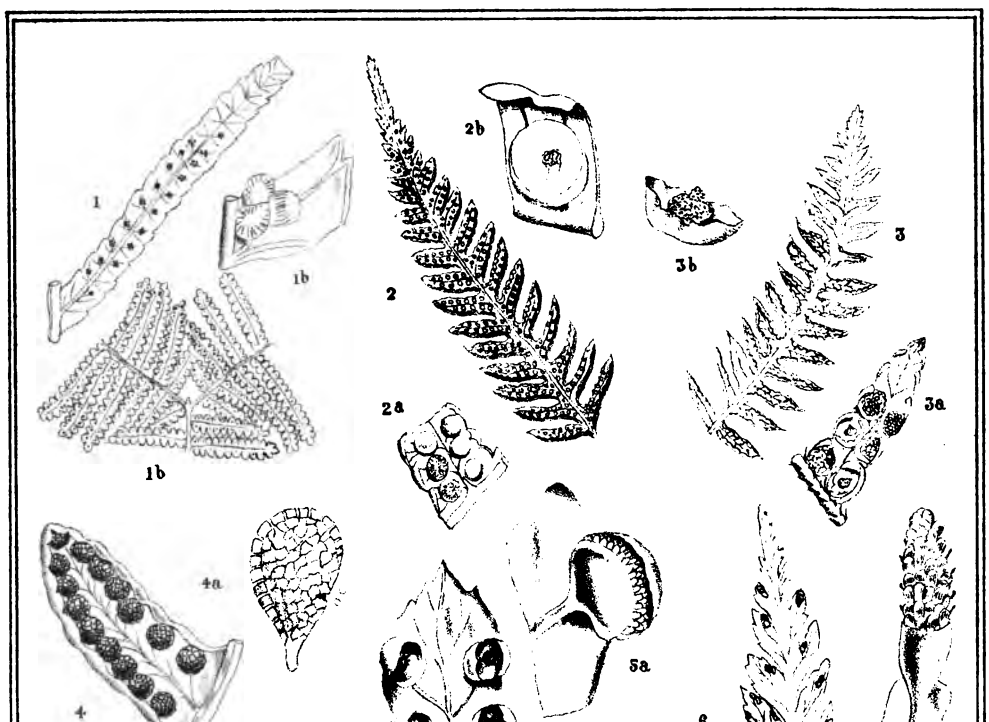
Plate I.



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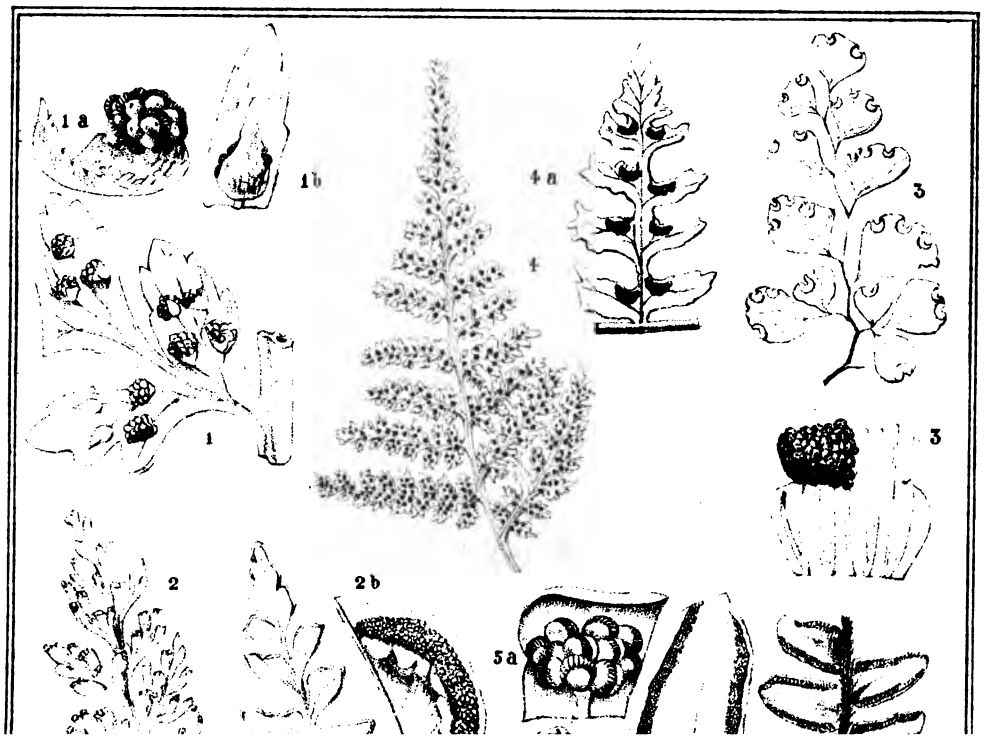

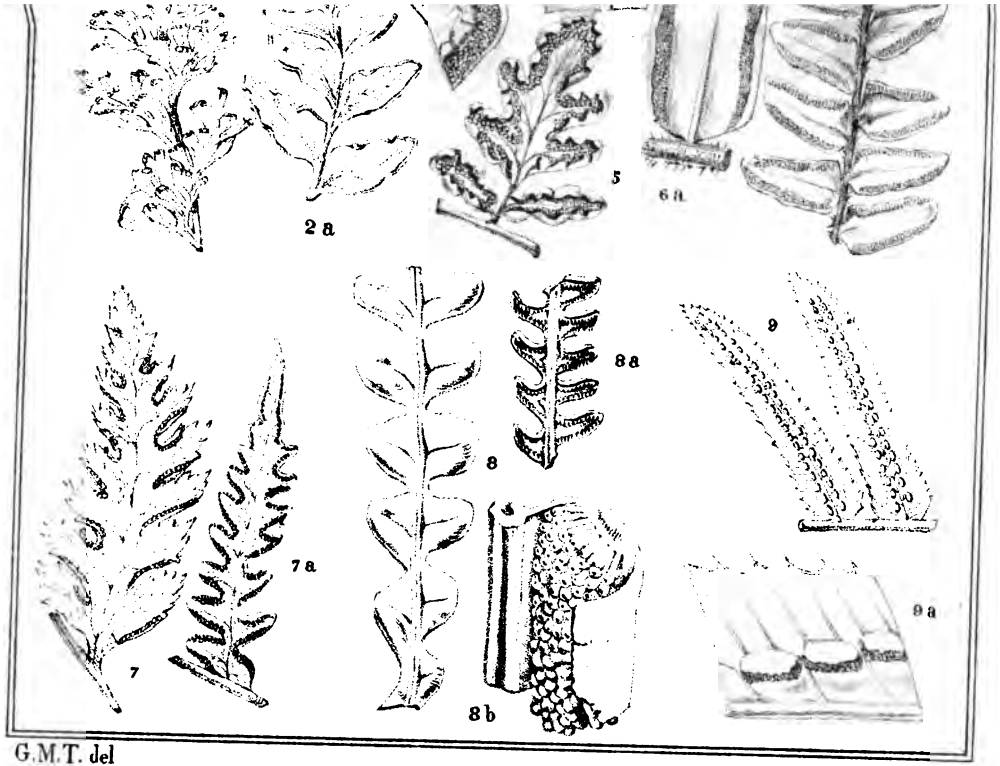

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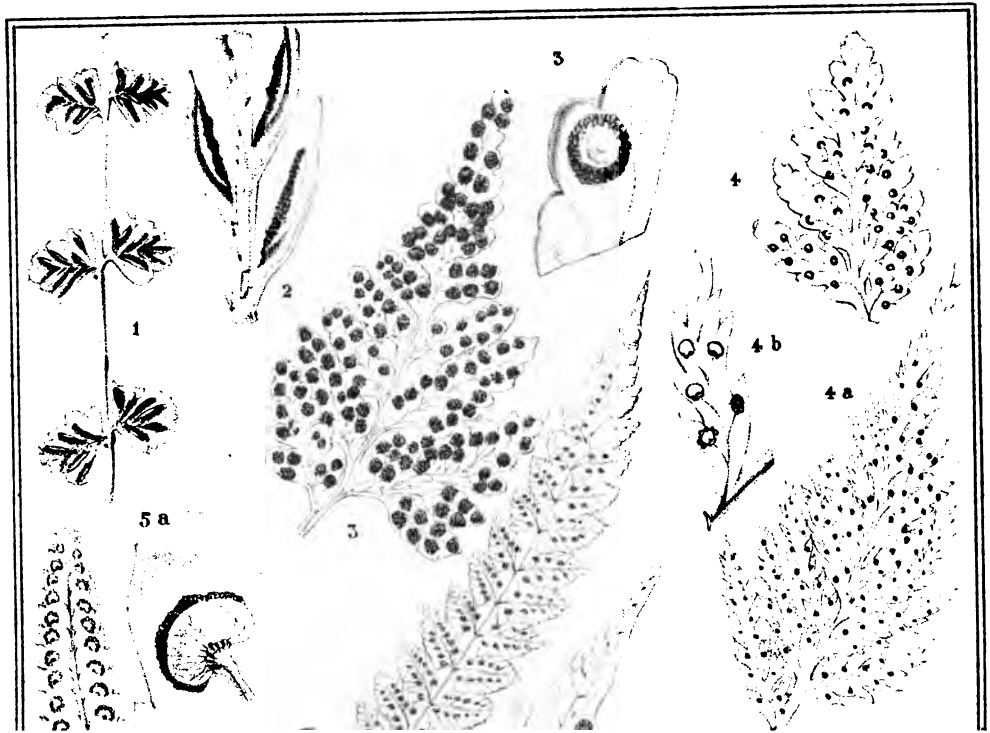

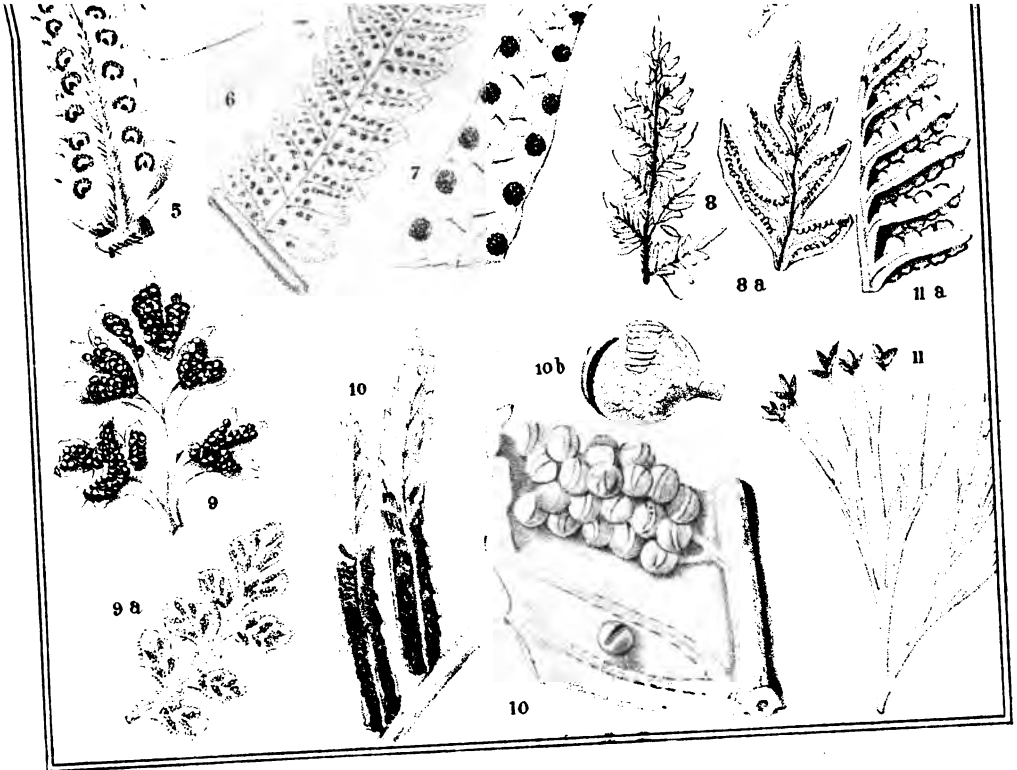

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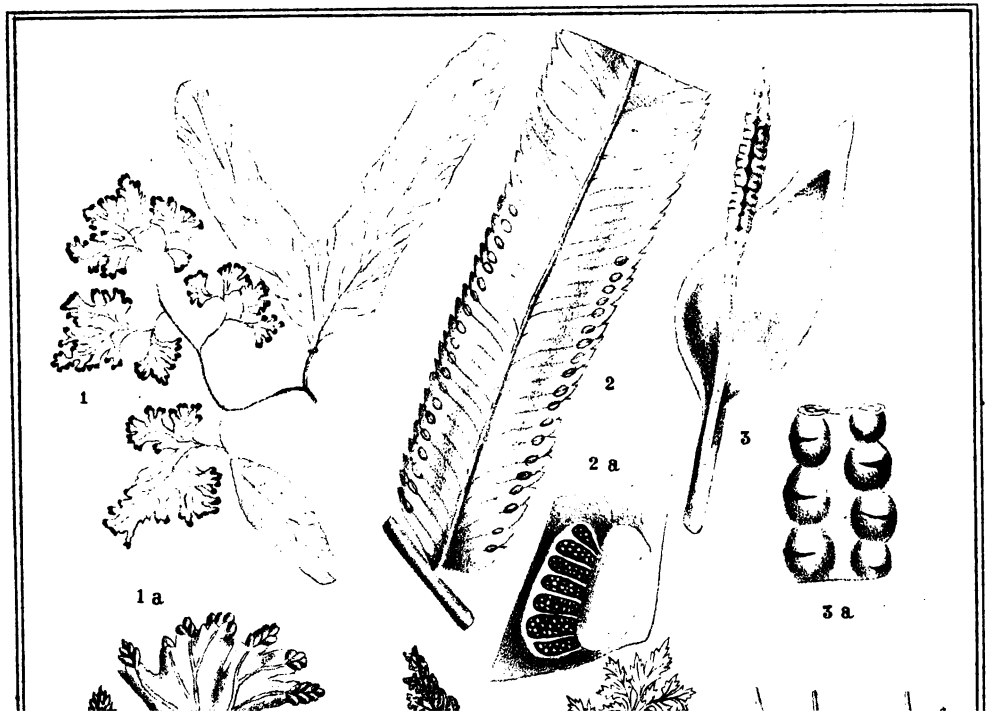

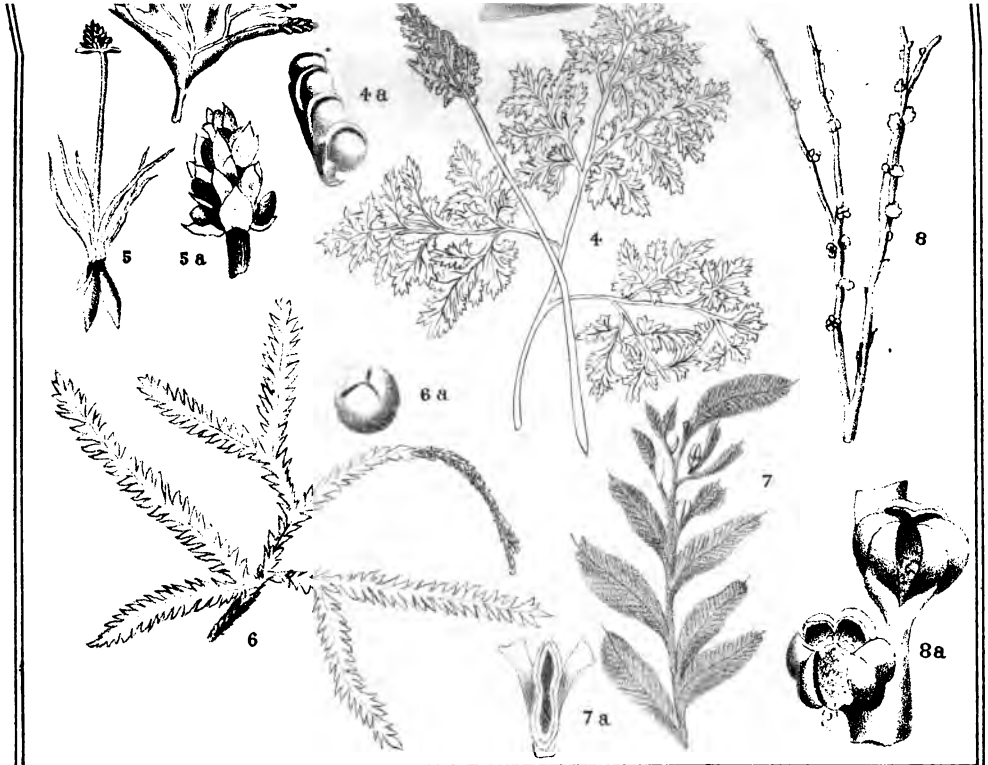

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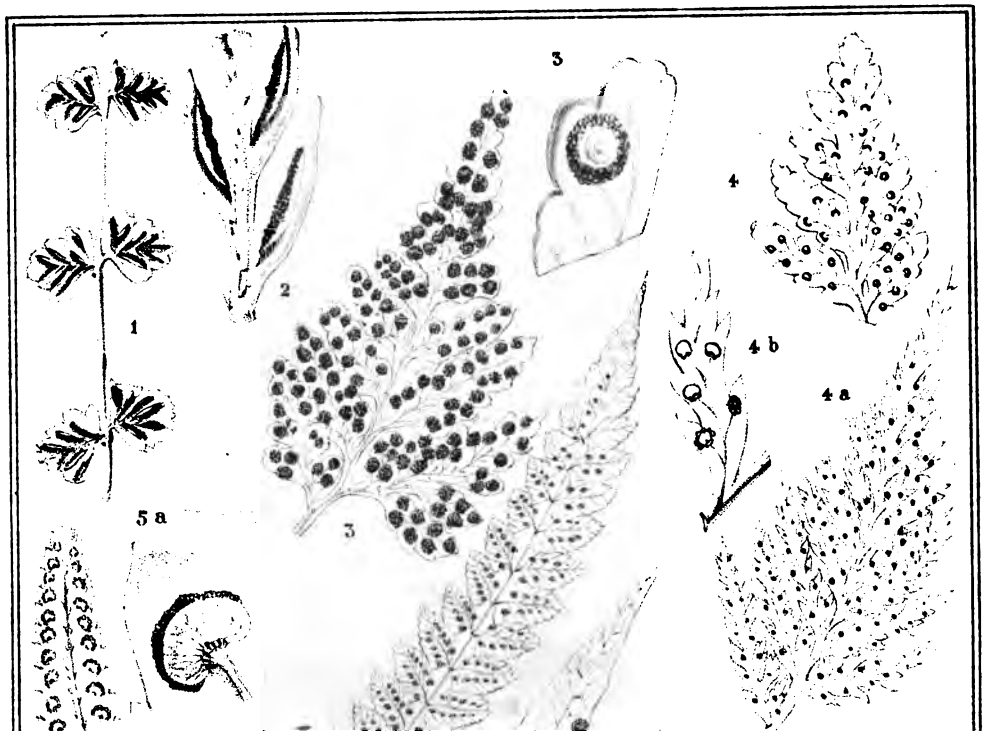

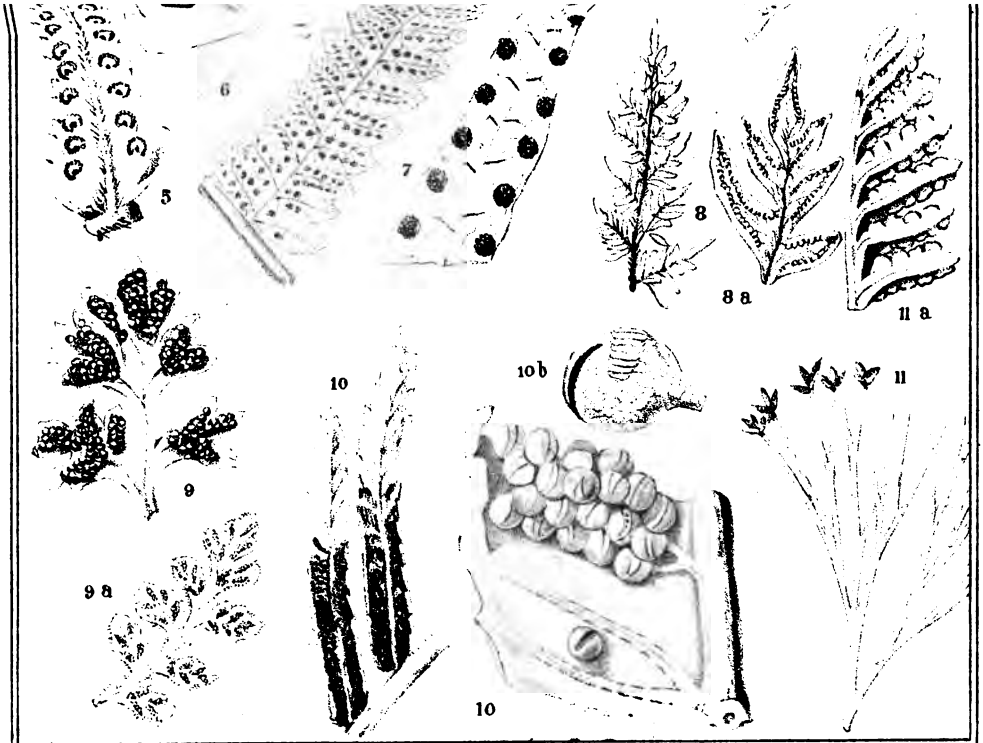

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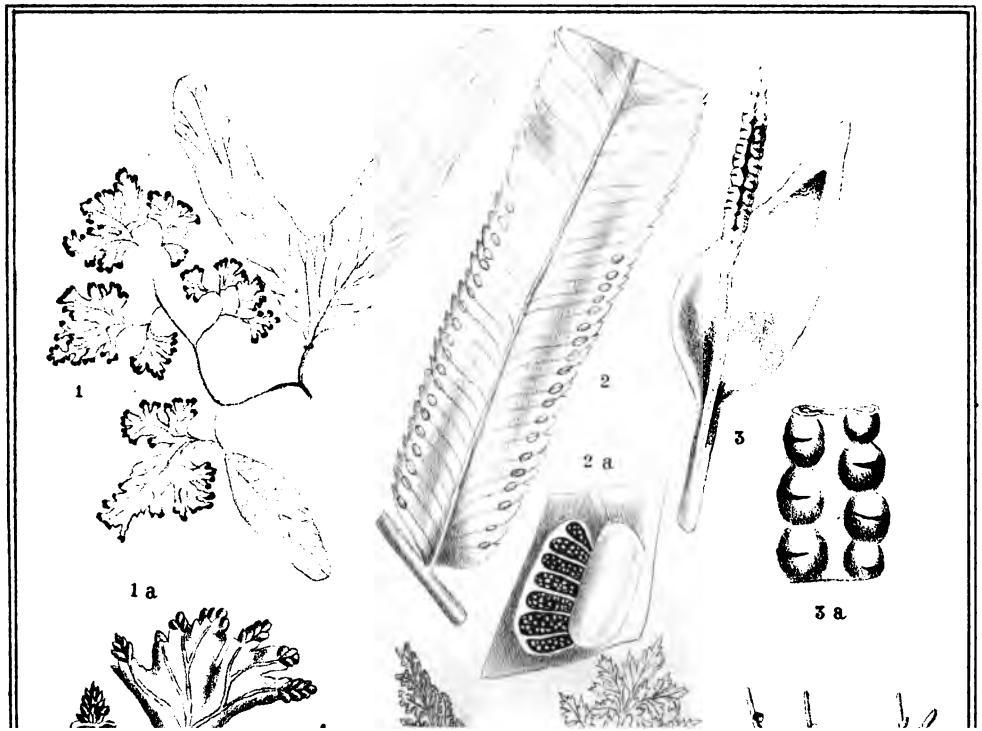
Plate IV.